Journal
of the
British Interplanetary Society

Vol. 9 No. 6 XXXVII November, 1950

ELECTROMAGNETIC LAUNCHING AS A MAJOR CONTRIBUTION TO SPACE-FLIGHT

By Arthur C. Clarke, B.Sc.

The idea of using some form of ground-based launching system for spaceships, such as a very long electromagnetic accelerator, has often been suggested in the literature.[1] There are two fundamental objections to such a device which make it very improbable that it will ever be used in practice to provide much of the escape energy from Earth, though it may well be used to get winged spaceships airborne. In the first place, a body moving at anything like escape velocity in the lower atmosphere would be rapidly destroyed by friction (note that the extreme nose of a V.2 became red-hot at about 2,000 m.p.h., and as escape velocity is 25,000 m.p.h. the heating would be at least 100 times as great). This could be only partly reduced even if the launcher was built on the highest mountain.

A second equally serious objection is raised by the impossibility of using very high accelerations for manned spaceships. Even if we assume that 10 g. could be tolerated by a properly protected crew, the launcher would have to be no less than 600 kilometres in length, and proportionately longer if lower accelerations were used. It is, therefore, obvious that an accelerating device of any practicable length could provide only a very small part of the total velocity needed to escape from Earth, and that at such vast expense and inconvenience that the whole job would be better done by rockets.

This is particularly unfortunate, for an electromagnetic launcher or catapult would have great advantages, the most important of which arise from the fact that the energy of take-off would be provided by fixed and not mobile power-plants. Such a system is fundamentally more efficient than any arrangement using rockets, where the greater part of the fuel is required merely to accelerate more fuel, and therefore, in a sense, does no useful work at all. Electrical energy, on the other hand, possesses no mass and so it requires no extra power to apply it to a body in motion.

The great reductions in mass-ratio which would be made possible by orbital refuelling have often been pointed out,[2] and clearly this technique would become even more attractive if fuel could be projected into free orbits by means not involving rocket propulsion. It is also widely recognised that interplanetary travel will not be practicable on the large scale until propellants can be obtained on the Moon, with its very low gravitational potential. The idea therefore suggests itself rather forcibly, that, unless other developments make it unnecessary, a possible long-term solution to the space-flight

problem may be found in the use of electromagnetic accelerators on the Moon, launching the fuel mined there into suitable orbits round our satellite.

The Moon's low escape velocity (2·3 km./sec. as against 11·2 km./sec. for the Earth, with a consequent reduction of kinetic energy per unit mass to 1/20), and its virtual absence of atmosphere, make it an ideal site for an accelerator. If we are considering only the projection of fuel supplies, and not manned spaceships, then large accelerations can be employed, and the launching track need be only a few kilometres long. At 100 *g*, for instance, escape velocity would be reached in a distance of less than 3 km., and a gently rising track of this length must be regarded as a reasonable engineering proposition. (It could even be horizontal if it was constructed on a plateau or open plain with no mountains in the line of sight.) The operation and technical characteristics of such a system will now be investigated.

General Principles

Circular velocity near the Moon's surface is 1·65 km./sec., but a body projected at a slight upward angle at this speed would return to the Moon again. The fact that any orbit must be symmetrical about some line through the centre of the Moon shows that it is impossible to fire a body from the surface into an orbit that does not either go to infinity, or else return to the surface again. However, if the initial speed is a little greater than circular velocity, the use of a very small amount of rocket power when the missile is at its greatest distance would convert the orbit into a stable, circular one. A suitable projection speed would be about 2 km./sec., which will be used as the basis of the following calculations.

If a constant acceleration of 100 *g* were used, this speed would be attained after 2 seconds and in a distance of 2 km. 100 *g* is quite a modest acceleration—artillery shells experience accelerations of the order of 10,000 *g*, which would give circular velocity in 20 metres! However, power and constructional problems would be more easily met if values of not more than 100 *g* were utilised.

To give a mass of 1 tonne a velocity of 2 km./sec. would require the expenditure of 2×10^{16} ergs, or 2×10^{9} joules—an average power, over 2 seconds, of 1,000,000 kW. With the use of a uniform acceleration, the power required would rise linearly from zero to 2,000,000 kW at the end of the 2 seconds. (Fig. 1.) It must be realised, however, that there would be no need to build electric generators with a continuous rating of anything like this value. All the energy required for a "shot" would be stored up—perhaps over several hours—by bringing large flywheels up to speed and then coupling them to generators designed to deliver high currents for very short periods, and hence capable of withstanding enormous overloads. (This was the technique used by Kapitza at the Mond Laboratory to obtain very intense magnetic fields for his experiments in low-temperature physics.)

Since the use of a constant acceleration necessarily implies a continuously increasing power, it would be more realistic to assume that the amount of power available was fixed, and to calculate the resulting acceleration, velocity, and distance, relations. If the power available per unit mass accelerated is *c*,

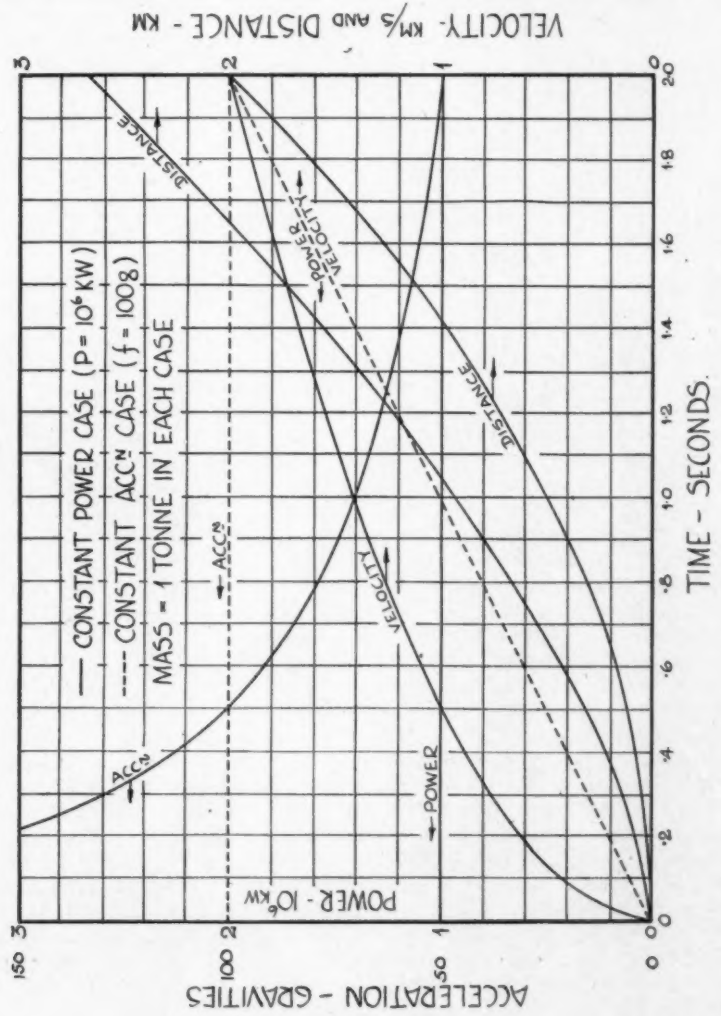


FIG. 1

the mass is m, and the total power is P, then with the usual symbols f, v, s, and t, we have these relations:—

$$P = mfv$$
$$\therefore c = fv \quad \ldots\ldots\ldots\

Hence $$f\frac{dv}{dt} + v\frac{df}{dt} = 0$$

or from (i),

$$\frac{df}{f^3} = -\frac{dt}{c}$$

$$\therefore f = \sqrt{\frac{c}{2t}} \quad \text{.....(ii)}$$

(since $v = 0$ when $t = 0$).

Also $$v = c/f = \sqrt{(2ct)} \quad \text{.....(iii)}$$

and $$s = \int v\,dt = \frac{2}{3}\sqrt{(2c)t^{3/2}} \quad \text{.....(iv)}$$

Taking the case $P = 10^6$ kW, $m = 1$ tonne, we find that a launching track 2·67 km. long would be required, while the time to reach 2 km./sec. would be 2 seconds, as before. The acceleration would begin at a very high value (in theory, infinity) and would fall to 50 g at the end of the 2 seconds. (Fig. 1.)

In practice, of course, the power would not start suddenly at the full 10^6 kW value, but would rise from zero, and the acceleration would start at some limited initial value. The power would also be expected to drop during the shot, as the kinetic energy stored in the flywheel was absorbed, and for these reasons the length of the launching track might have to be increased to about 3 km. Alternatively, a second "booster" generator could be brought into operation near the end of the shot. It is worth noting that the 2×10^{16} ergs necessary per launch equals the energy of a 50 tonne flywheel, radius of gyration 2·2 m. revolving at 1,200 r.p.m.

This paper is not primarily concerned with the engineering details of such a system, but it is interesting to note that a similar device, known as an "Electropult," has been developed in the United States by the Westinghouse Corporation.[3] This consists essentially of a large induction "motor" laid out flat into a 1,400 ft. long track, with a small shuttle, carrying the aircraft, which acts as a "rotor." The power supply comes from a 750 kW d.c. motor, driving an alternator with a 24-ton flywheel working at 1,300 r.p.m. The power transmitted during take-off is 12,000 kW and a fighter can be given a speed of over 100 m.p.h. in 4 seconds, after a run of only 340 ft. It will be seen that in many respects this system is a miniature replica of the one discussed above.

It is, of course, quite possible that other methods of launching than electric might be preferred, since such a machine could not be built until the lunar colony had established engineering plants on the largest scale. The use of chemical energy (as in the V.1 launching track) might be a simpler solution, but the electrical method would have the advantage of better control and much lower running costs, if the use of solar or atomic generators is assumed.

Operating Features

It has already been mentioned that though such a launcher could shoot a body completely away from the Moon, it could not project anything into a

closed orbit of the type desired for refuelling. It, therefore, remains to be seen how much additional rocket power would be needed for this.

We will assume that the launcher is horizontal, with no obstacles in the line of flight. The orbit of a projectile fired at 2 km./sec. is shown in Fig. 2. It would reach a maximum distance from the Moon's centre at *B* of 4,760 km. and would return to its starting point after $2\frac{1}{2}$ hours. The velocity at *B* would be

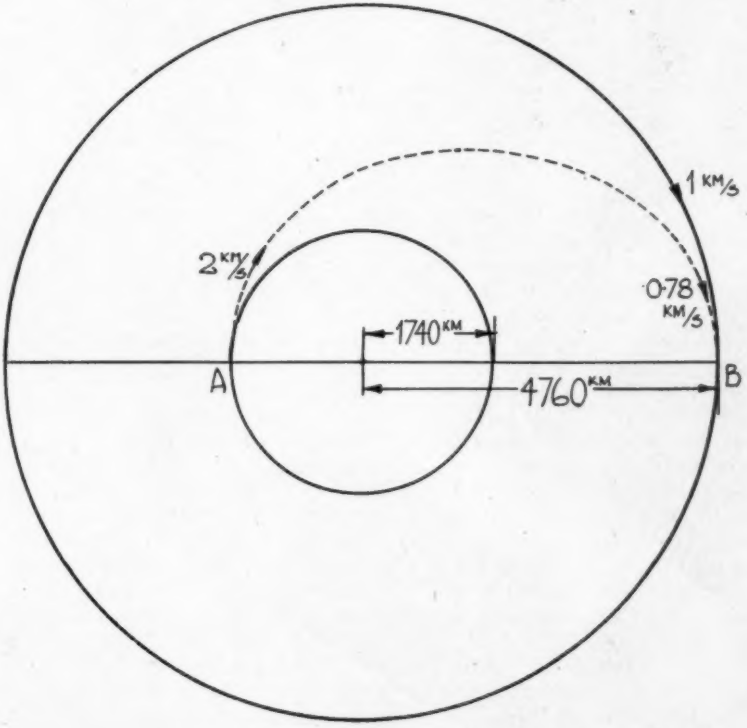


FIG. 2

0·78 km./sec., and circular velocity at this point is 1·00 km./sec. Hence an additional velocity of 0·22 km./sec. must be given to the missile at *B* for it to remain in a circular orbit. If we assume that the projectile carries a small rocket motor with an exhaust velocity of 4 km./sec., it would, therefore, be necessary for it to eject about 60 kg. of propellant per tonne of initial mass. This 6 per cent. penalty is trivial. Rather more serious would be the weight of the motor and the resulting complexity of control circuits, etc. to ensure that the impulse was provided at the correct moment.

This difficulty might be avoided if somewhat greater launching velocities

were used and the missile was sent away from the Moon on a very elongated orbit with a period of several days. At extreme range it would then be moving very slowly and there would be plenty of time for fuel transfer operations. It would not matter if the (relatively light) empty containers then crashed on the Moon when they had completed their orbit.

In principle, therefore, if we assume that in due course it is possible to set up a self-supporting lunar colony, and that all the normal minerals can be found on the Moon; it would appear possible to establish large fuel reserves in space almost entirely by means of electrical energy. One could imagine the setting up of an orbital satellite, at a height of a few thousand kilometres, whose task it would be to collect the fuel carriers as they were propelled upwards into its orbit. (It might be equipped with a number of small tanker rockets whose duty it was to make the transfer, thus obviating the need for any propulsive mechanism in the carriers.) It is hardly necessary to point out that some care would be needed to avoid "shooting-up" the space-station! The high degree of control possible with an electric launcher would help to avoid such unfortunate accidents.

The possibilities opened up by a moon-based launcher are by no means exhausted here. Dynamical considerations indicate that to project a body from the Moon into an orbit *round the Earth* requires only about 20 per cent. more initial velocity than to project it into a path around the Moon. Hence spaceships after take-off from the Earth could be refuelled more economically from lunar sources than from the planet only a few hundred kilometres below. This would certainly involve severe problems in missile control, but little expenditure of rocket power. If this technique becomes feasible, then the problem of Earth-Moon travel is enormously simplified. No spaceship need ever be designed for any mission more difficult than the entry of a circular orbit round the Earth, since refuelling would be possible both in circum-terrestrial and circum-lunar orbits. The total amount of propellant required would be reduced to a small fraction of that needed if rocket power was used exclusively, for if sub-orbital techniques were employed as normally envisaged, colossal quantities of propellant would still be required to get small amounts of fuel into position.

Looking further afield, it should be noted that initial velocities of only 4 km./sec. would project material from the Moon to Mars or Venus under the most favourable conditions. Until such time as refuelling operations can be carried out on these planets, the Moon-based launcher might well provide the key to interplanetary as well as lunar travel.

Still further in the future, it is interesting to speculate on the use of launching systems which are themselves in space, either as adjuncts to space-stations or as independent structures. One of the chief problems to be overcome in this case would be that of momentum change and the preservation of the launcher's orbit despite its ejection of material. Whether such engineering feats ever become necessary only time will tell. Since there seems no physical limit either to the lengths or accelerations which might be utilised in this case (if sufficient power were available) such projectors may conceivably play a part in the development of interstellar flight.

Ignoring these remote speculations, the lunar launching system is of importance since it could, in theory, make interplanetary travel practicable with propellants of a much lower exhaust velocity than any assumed hitherto. Even chemical fuels might then be adequate for the task. Of course, there is still the tremendous initial problem of establishing the lunar colony and building up its industrial potential—but this is a problem which has to be solved in any case. We are rather in the position of trying to run a trans-Atlantic airline when there is no possibility of refuelling on the other side until we have drilled our own oil-wells and set up our own refineries!

It is quite possible that other technical developments, such as the successful harnessing of atomic energy for rocket propulsion, may make such schemes quite unnecessary. But if not, it is as well to keep the Moon-based electromagnetic launcher in reserve as a solution of the long-term problems of spaceflight.

REFERENCES

(1) "Akkas Pseudoman" (Dr. E. F. Northrup), *Zero to Eighty* (1937).
(2) H. E. Ross, "Orbital Bases," *J.B.I.S.*, Jan., 1949; K. W. Gatland, "Rockets in Circular Orbits," *J.B.I.S.*, March, 1949.
(3) *The Engineer*, **182**, 379–80, 25th Oct., 1946; *Westinghouse Engineer*, **6**, 160–1, Sept., 1946.

ESSAY COMPETITION

Report of Publications Committee

The general level of the 19 entries in this competition was disappointing. In arriving at their verdict on the essays the Publications Committee looked for two main features—(1) literary quality and (2) originality. Both were in rather short supply, and although some contributions contained interesting ideas and viewpoints, few sustained a sufficiently high level throughout.

The most popular subject, as might have been expected, was "Why Interplanetary Travel Interests Me," followed next by "What I think the B.I.S. Should do to Hasten the Conquest of Space." Only three entries were received for "How I Believe Man will reach the Moon." (One of these, on 29 pages of foolscap from the Eastern Zone of Germany, easily set the record for length but attempted a more technical treatment than was suitable for this competition.)

The male contributors may like to brood over the fact that two of the first five places were secured by the only woman entrants—one of whom produced what was easily the most *entertaining* essay submitted, as readers can judge for themselves, since it is reprinted in this *Journal*.

In the essay "What the B.I.S. should do," few novel or original ideas were forthcoming. The general verdict seemed to be that the Society should continue to do what it is doing now—but if possible, more of it. On this subject it was interesting to note a conflict of opinions over the commercial aspects of space-travel. One member suggested various ways in which finance could be attracted to the idea of astronautics, and considered that the first duty of the B.I.S. should be to "sell" the space-station, with its "world-wide television coverage, its survey facilities, its no-gravity laboratories, its temperature ranges and its hard vacuum and observatory." Another contributor, on the other hand, was anxious that the impetus behind the conquest of space should

come, not from "commercial tycoons, but from the concerted efforts of the real enthusiasts." Many tended to deplore the concentration of rocket research into the hands of the military. There were also some pleas for the establishment of a world-wide astronautical society—in the eyes of the judges, a most laudable ultimate aim, but surely one that is administratively impracticable for the present.

One recurrent theme was the service which science-fiction had done to astronautics, by introducing many to the subject and by keeping it in the public eye. Indeed, it would appear that for the majority of the contributors this was the first source of their infection by the interplanetary virus.

The three winning entries are reprinted below; for the rest, we cannot resist quoting one competitor's statement that the recent war "had two major effects: 1. It caused the temporary cessation of the activities of the B.I.S. and 2. It accelerated the science of rocketry. . . ." Such single-minded devotion to our cause deserves at least some honourable mention!

WHY SPACE TRAVEL INTERESTS ME

By D. J. Cashmore, B.Sc.

Why, indeed, should space travel interest anyone?

Much has been ventured about what lies behind such societies as the British Interplanetary Society—especially by such societies as the B.I.S. itself—and there is a very good reason for this. If the B.I.S. values its own existence it must endeavour to show the community at large that space travel is a fascinating idea and that it is a worth-while project. The members of the Society are in constant touch with the general public, apart from the *Journal* and the organised meetings and lectures, so let us imagine a member and a non-member discussing the Society and what it is all about. Before many seconds have passed the non-member is sure to ask "But *why* do you want to go flying off to the Moon?" What will the member say? *He* should know.

If the B.I.S. circulated among its members a questionnaire to discover why each is interested in space travel, would every member be able to give a reason? Could such a questionnaire be drawn up? I cannot pretend to draw up a comprehensive list of "reasons why," but let me offer some material for thought.

The astronomer (in the words of Willy Ley) will embark on the third era of discovery, the second having begun with the telescope. An observatory on the Moon or in an orbital station would enable much larger instruments to be used due to a reduced or eliminated pull of gravity. In the absence of an atmosphere the full frequency spectrum would be available, and much longer photographic exposures could be made. The problems of the Martian "canali" and the dark areas on the Moon would be solved; spectrograms of the Earth could be obtained; and so on endlessly.

Physicists and chemists would have immediately available an infinite pressureless space, access to a very large temperature range and in an orbital station the lack of weight would give invaluable information on molecular structures, etc.

Atomic engineers would be able to dispose of "hot" waste products by

sending them into the Sun, and playing with atomic energy in open space would be much safer—at least from the point of view of the local inhabitants at the research stations on Earth.

The presence of a large hard vacuum would soon attract electronic and radio engineers. Orbital stations would solve the problem of short wave coverage on Earth (including television) with immense saving in cable and ground stations.

Biologists and medical scientists could learn about the effect of gravitation on tissue growth, the survival of bacterial spores in space, etc. Perhaps those who suffer from cardiac diseases would find relief in the weaker gravitational field of the Moon.

From the Moon and from orbital stations, meteorologists could watch storm centres moving across the face of the Earth and thus be able to make more accurate forecasts. Shipping and aviation will benefit as a result and also as a direct consequence of observers being able to track ships, large aircraft, wrecks, expeditions, etc. from an orbital station.

Further afield on the other planets, more possibilities exist which I shall not attempt to enumerate. There is no doubt that a list of this type can be extended much further; it might be interesting to keep one up to date. But at this stage the non-member would have the strong conviction that space travel is a scientific project, suggested by scientists for the benefit of scientists. He might admit that what the scientist gains in the way of new knowledge is adapted to make a better world for everyone to live in—on the other hand he may enquire whether a bomb bigger than the hydrogen bomb has been thought of yet. In fact, the non-member might suggest some more items for the list:—

Military forces would be strengthened a great deal by the use of rocket-propelled vehicles and by developing guided missiles. Moreover, an orbital station or the Moon offers an excellent base for reconnoitring the Earth or for launching guided missiles. With a monopoly of rocket techniques and control over the development of space travel, powerful and unscrupulous groups could sway the balance of power to their advantage.

The non-member might add that he hates to think of what the commercial world would make of it; the advertisements of Lunar rock for sale—"Get Your Girl the Moon"; the numerous "Cafés de la Lune" with the waiters in space suits.

No, there is still something missing. This catalogue of items does not give the real reasons for wanting to voyage far from the Earth.

One obvious attraction is that of physical adventure. Nowadays there is little of the Earth's surface which has not been explored and the adventurous spirit of the explorer will find a vital expression on other worlds. There is little need to emphasise this for a high percentage of science fiction stresses as hard as it can. In fact, I believe that a very large number of members were introduced to the fascination of space travel by having their imaginations fired during impressionable youth by the ever popular sagas of science fiction. Indeed, I imagine that the drama and heroism of these highly imaginative sketches are still and may always be a mainspring of interest to a great number of people.

When an engineer is confronted with a problem of construction, he finds much satisfaction in tackling it and hunting for a solution. Most of the problems posed by space travel have been as yet only tentatively approached and there is still a very wide scope for ingenuity and invention. But although these engineering problems are new and new techniques have to be developed in the design of propulsive systems, etc., the underlying urge is common to all branches of engineering—the satisfaction of invention and construction.

Deeper still lies the love of knowledge for its own sake. Science in all its fields owes its advances—indeed its very existence—to the urge of curiosity. For the scientific mind, phenomena which do not fit into the accepted scheme of things are a challenge and at the same time a fascination. This drive of curiosity lies behind the list of scientific gains which our friend the non-member found so unconvincing. It gives a power and vitality to any scientific work and its satisfaction is a sufficient reason and reward to workers in many fields of science—and not the least in the field of space travel.

To any philosophical mind the love of knowledge and truth is a fundamental force. The vast increase in scope for enquiry in all branches of human thought that will surely be afforded by the spread of man in the solar system, is an irresistible attraction to the philosophic mind. The immense expanse of knowledge that will follow hard on the heels of the first space vehicles may well be knit into a new philosophy. At first, this will affect only the more profound thinkers, but gradually a new way of life, a new viewpoint will spread through humanity. Man-made conveyances and communications, culminating in the modern aeroplane and radio, have already gradually broadened people's viewpoint so that they are aware of and can be in touch with most of the Earth's surface. This has inevitably coloured the modern way of life with an appreciation that there is a very great fund of experience available to man, much greater than was available to past generations. How much greater will the scope of experience be when man travels to the other worlds!

Contemporary science gives no definite answer to the much-asked question: "Is there life on other worlds?" The possibility that a lowly plant life exists on Mars and even on the Moon is admitted and such possibilities are perhaps representative of the most intriguing aspect of travel to other worlds. Speculation in this field of the imagination has brought forth the all-too-numerous monstrosities which haunt the pages of science fiction, but these tiresome horrors contain the seed of profound ideas. If the human race should come into contact with intelligent life of a different order, such a meeting could well be the most far-reaching event ever to happen to man. Intelligence with a diversity of life forms, some perhaps based on quite different physical and chemical processes, would enrich the experience of man to an extent never known before.

When men have travelled throughout the solar system, from shrivelled Mercury to frozen Pluto, will there be an end? I do not believe so. As men's machines cross the empty spaces between the planets, the cold light of the stars will shine and the age-old call of adventure both of body and mind and the thirst of curiosity will still be as potent as ever.

Yet, for all this, there are but relatively few who know these thoughts and

feelings. Much of humanity is still stricken with poverty and misery, tragedy and war. Some find happiness and peace, some only briefly. Few lift their eyes to the stars and many of those who do, plan rockets and orbital stations for war. The same age-old forces struggle for expression in human nature; the lure of adventure, drama and heroism; the impulses to strife and war; the love of knowledge, truth and beauty; the temptations of vanity and selfishness.

When man leaves Earth in the first space-ships the good and the bad will go out with him. But do the words "good" and "bad" really mean anything? Do human values have universal validity? Perhaps contact with other creatures of the Universe will teach us something. But now I am out of my depth.

Yet, as I listen to Holst's "Neptune" fading into emptiness, and as I try to picture the distance to the stars, I cannot help but be thrilled and awed.

WHAT THE B.I.S. SHOULD DO TO HASTEN THE CONQUEST OF SPACE

By Mrs. M. E. Patchett

Do I think the B.I.S. should hasten the conquest of space? Well, I don't know, but I can think of some things members could do to "wait with speed." My own feeling is that this most tremendous achievement of man should be prepared for physically and mentally, possibly prayed for, but *not* hurried.

As a woman, the B.I.S. interests me vitally because my son's son could be the first man on the Moon. I believe that unless man reaches the Moon with his brains as much as with his body, he is going to make a fine old mess. I think space travel should be held up until man's philosophy is ready for it, but that it should *not* be held up for lack of money. Brains are not much use without equipment for experiment and the leisure for study. These things cost money, and until the common man is interested in it, and the aspiring M.P.'s promise it support to catch votes, it will be difficult to raise the necessary amount of money, for the whole thing must be, to some extent, commercialised. Women must be interested and sympathetic, for in a way space travel affects women more than anyone; interest, understanding and publicity brings money, and without money none of the things can be accomplished that must lead up to that first great, momentous flight.

Perhaps it is because I am a woman that I believe you will *never* cross space without the support of women *en masse*. Once sell women the idea that space travel is the natural destiny of her sons and you can go ahead, but—spring it on her that her husband, son or lover is leaving for the Moon whether she likes it or not, that they will travel inside a relatively frail metal shell, and beware of what will happen to your scheme if you have not prepared the ground very carefully!

As I look around me at B.I.S. meetings I often wonder just how many of you ever lift your noses far enough out of those pages of squiggly figures to see that women are a most potent weapon in the hands of the B.I.S. Probably most of you accept the women in your lives as you would an old bird or dog you have had around for years, and just a few, just a *few* I think, with minds filled with the problems of space would, if they were suddenly asked to define the

word "mother," have a startled vision of a knee, a bosom, and not much else; mother, as she was to the Victorians and kept in her pristine condition by a continual flow of mathematical spots before the eyes!

Women *can* be more than this. It is still the fashion for women to have the children, and unless trained to be intelligent mothers, their children will be handicapped from the start. If we are to travel, perhaps even to people other worlds, surely we will want sane and sound emigrant stock. Children usually arrive in the world undamaged in transit, after that it is firstly up to the mother, and after up to man himself to keep it that way, and both of them often make a pretty rotten mess of it. Man seems to forget that the human body is a more wonderful thing than any he can dream up from steel and hydrogen, mathematics and atoms, but if he is going to hasten the flight of his brain-child he had better learn to take care of his body; a brain stuffed with science is a valuable B.I.S. property, but it can pop off with something as childish as measles just as easily as the emptiest brain!

Women are far more logical than men, they know that it is nonsense to insist that two-and-two *must* make four, and they are practical too, they need a goal for their children. Interplanetary flight supplies such a goal, it has all the ingredients that appeal to women. Whatever freaks among my sex may say, women still like their men to have qualities and courage far outshining their own, a mental and physical make-up that does not "flinch from death and darkness knowing they are there."

Remember that life, to many women, consists of planning one meal after another, of keeping Johnny from annoying dad, with bridge or the cinema thrown in—it is dull, dull with a dullness so solid you could train ivy up it. Change this, sell space travel to women by remembering the seven reasons one successful salesman gave for women buying *anything*. The reasons went this way: Her husband says she cannot have it; it makes her look thin; it comes from Paris; her neighbours cannot afford it; nobody has one; everyone has one; it is different. Believe it or not, all these reasons could be adapted by an ingenious interplanetary enthusiast.

Now, I am by no means a feminist myself, in fact, I sometimes doubt whether it was a good idea to give women the vote, especially at such times as once when a staunch Conservative told me she voted Labour after the war because she thought "poor Mr. Churchill must be *so* tired," but I do think my sex has inordinate zeal when once harnessed to an ideal, and a very desirable goal would be one to divert the energies of those women who seem to feel that man's world is the only world left for them to conquer.

Personally, I would just love to follow the first flight to the Moon from a comfortable chair in front of a television set, and I only want to be the first woman on the Moon after h. & c. has been laid on by some enterprising male; but then I have long passed the age when I have to show off about a boldness I do not possess. I certainly hope there will be plenty of Amazons carrying banners round Trafalgar Square in protest against an all-male crew on the first Moon-journey, shouting "Unfair to Moon Maidens," and I hope, too, that they will be left to shout until they turn their energies towards raising children, and maybe money, for more and better Sky Clippers.

It was a woman who asked Lloyd's for an £18,000 insurance to cover the return trip to Mars. She is only one of 10,000 people who have applied for reservations at the Space Travel Bureau of the American Museum of Natural History for the first commercial interplanetary flight, and, speaking of money as a primary need for the more rapid conquest of space, why not have a similar bureau in England? What do you care if you are dead and gone before interplanetary flight becomes a commercial possibility? The interest of booking gives a wonderful publicity angle and the chance to spread interest via information.

Money buys advertising and advertising brings interest. Why not things for sale at the bureau? Books, postcards, prints, Christmas cards, souvenirs for our Atlantic cousins, toys, everything with an interplanetary interest. Just let English women get the idea that it is a pity for their men folk to do all the work towards a Moon flight, and then have no chance to reap the rewards because inflation is the only thing round here with escape velocity, then see how they will help! Let women have a go, and all you men will have to worry about will be negligible things like gravity, the speed of flight, and having pogo sticks handy for landing.

Roping in women as hurry-uppers of interplanetary journeys is really only a logical way of getting the children. It is the children of to-day's children who will be the real travellers into darkness, it is this future generation that will have "the Moon to play with". These children will begin where you leave off, and will inherit the total sum of your knowledge, and unless they are wise and strong and gentle it will be a pretty poor lookout for this and for other worlds.

Why not start a junior B.I.S. society and magazine—or a junior B.I.S. supplement affiliated to something like Hulton's new children's magazine, *Eagle*? Do not tell me that the scientific tycoons among the adult B.I.S. members and fellows would not have as much fun as the kids would have with that—Mr. Clarke with his gadgets, Mr. Gatland with his models, why—it's money for jam! And please do not scorn the popular science stuff including flying-saucers; me, I loved that 23-in. man who crashed in Mexico, and I will never forgive Mr. Smith for making him melt right into thin air off his saucer.

If you want to hasten Moon-landing day, never underestimate the power of women *and* children, and do not let speed interfere with safety, for if the first attempt of a manned missile ends in disaster, speed will have been in vain. Remember the lion that ate Albert, "orse's 'ead 'andle and all", and how indignant Albert's parents were at the keeper's suggestion that they could have more Alberts? I think they replied something like this:—

"Have kids to feed your ruddy lion? Not bloomin' likely!"

It will be quicker in the end to make haste slowly, to see that the first journey is a safe one, or women will find a way to keep their sons from feeding *your* ruddy lion!

WHY INTERPLANETARY TRAVEL INTERESTS ME

By V. B. Gerard, M.Sc.

To attempt to explain why interplanetary travel interests me, it is necessary to cast my mind back over a number of years to search for a time when the fascinating possibility of interplanetary travel was unknown to me. Then I

must try to remember what originally inspired my interest in such a fantastic subject. It was, indeed, fantastic in those days, for it was in the year 1934 at the tender age of ten that an uncle presented me with an early copy of a well-known American science-fiction magazine. I read the stories not once, but many times and tried to find more of their kind. But science-fiction magazines were rare in New Zealand, and indeed, are still uncommon; so my youthful imagination had to be contented with the few science-fiction novels available. Stories by Wells, Verne and E. R. Burroughs were well known to me long before I possessed any scientific understanding of space travel.

No doubt a psychologist would have interpreted this unusual interest of a young New Zealander as an escape mechanism to avoid the worries and difficulties of life on earth as a terrestrial. Be that as it may, while my contemporaries braved the Antarctic blizzards with Scott and Shackleton, or fought in darkest Africa; I explored the planets and their satellites, walked the surface of our Moon in a space suit and indeed, sometimes without one, if the neglectful author of the story had omitted to provide his hero with this essential piece of extra-terrestrial equipment! Evidently then, my earliest interest in interplanetary travel was basically an expression of that age-old urge or desire of mankind to explore and understand the unknown.

Passing quickly through the years to the present, the scientific side of my nature would now say that space travel is of immense interest because of the very great scientific advances that will come with it. It will be an even greater awakening for the world than that of Elizabethan times, which marked the closing of the Dark Ages and heralded the coming of Newton, Halley and the other intellectual giants of that time. I challenge anyone to name one science that will not undergo a change, with a broadening of ideas, after the first few interplanetary or even lunar voyages. Not only will astronomy and physics feel the impact, but even apparently unrelated sciences such as biology and geology will discover new problems as well as finding the solution to old ones. Perhaps even greater will be the change in mankind's way of thinking, for instead of being of Earth, man will have become an inhabitant of the solar system. Perhaps, too, in some remote era, man will become an inhabitant of this galaxy, as foreseen by modern science-fiction.

However, it is not only for science that man will go to the planets. He will go if only to satisfy the urge to explore. That urge which sent the early Polynesians across the vast Pacific, and which sent the Vikings to the New World long before the time of Columbus. That urge which in modern times has resulted in a not inconsiderable amount of knowledge about that last little-known portion of our planet, the Antarctic. Our southern polar cap will soon be well known. The time has come for our explorers to leave the planet of their birth and become space-borne.

In the past, periods of exploration have always heralded great cultural awakenings. Great will be the new age that will come with the exploration of our system of planets and satellites. In art, the new culture has already felt its first birth pangs with the paintings of Chesley Bonestell. I recently had the good fortune to acquire a copy of the book, *The Conquest of Space*. Bonestell's paintings therein amazed my friends, both for their art as well as their science.

Indeed, some at first glance, thought they were colour photographs taken with a new stereoscopic process!

A word of warning! Should mankind contact another intelligent race this cultural awakening will be even greater, but not if the new race is treated harshly as the backward races of this globe were treated by our forefathers.

Let us hope that the advent of interplanetary travel marks the maturing of our race. I think it will.

THREE EQUATIONS FOR RAPID CALCULATION OF ROCKET MOTOR THRUST

By Professor Hermann Oberth

Symbols

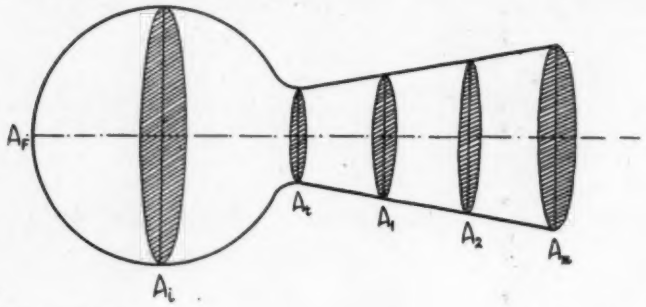
- A = any cross-sectional area of combustion chamber or nozzle.
- a = constant factor from equation (3).
- C = integration constant.
- F = thrust.
- k = adiabatic exponent (ratio of specific heats).
- p = pressure at any point.
- p_o = stagnation pressure, at burner head.
- T = absolute temperature (°Kelvin, = °Centigrade + 273·2).
- T_o = absolute stagnation temperature, obtained by adiabatic compression up to p_o.
- $\tau = \frac{T}{T_o}$ (see equation (5)).
- $x = \frac{p}{p_o}$ (see equation (2)).

Suffixes

- a total.
- e external.
- f concerning the chamber front wall or burner head.
- i concerning maximum chamber cross-sectional area.
- m concerning nozzle exit.
- o concerning theoretical stagnation pressure.
- t concerning throat section.

The thrust developed between A_1 and A_2 (see figure) can be expressed as

$$F_{A_1 - A_2} = \int_{A_1}^{A_2} p.dA.$$



In general, we have

$$dF = p.dA = p.A - A.dp \quad .. \quad .. \quad .. \quad .. \quad .. \quad (1)$$

For simplicity, put $p = p_o.x$; then

$$dp = p_o.dx \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad (2)$$

Using the well-known relation

$$\frac{A}{A_t} = \sqrt{\frac{\frac{k-1}{k+1} \cdot \left(\frac{2}{k+1}\right)^{2/k-1}}{x^{2/k} - x^{k+1/k}}}$$

and substituting

$$\frac{A_t p_o}{\left(\frac{k+1}{2}\right)^{1/k-1} \sqrt{\frac{k+1}{k-1}}} = a \quad .. \quad .. \quad .. \quad .. \quad .. \quad (3)$$

we obtain

$$A = \frac{a}{p_o} \cdot \frac{x^{-1/k}}{\sqrt{1 - x^{k-1/k}}} \quad .. \quad .. \quad .. \quad .. \quad .. \quad (4)$$

$$\therefore pA = a \cdot \frac{p}{p_o} \cdot \frac{x^{-1/k}}{\sqrt{1 - x^{k-1/k}}} = \frac{a x^{k-1/k}}{\sqrt{1 - x^{k-1/k}}} \quad .. \quad \text{(Compare (2))}$$

Introducing the expression

$$x^{k-1/k} = \frac{T}{T_o} = \tau \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad (5)$$

we obtain

$$p.A = \frac{a\tau}{\sqrt{1 - \tau}} \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad (6)$$

Considering now equations (2) and (4), we obtain

$$-\int A.dp = -\int \frac{a x^{-1/k}.dx}{\sqrt{1 - x^{k-1/k}}} \cdot = a \frac{k}{k-1} \int \frac{-\left(\frac{k-1}{k}\right)^{-1/k} x}{\sqrt{1 - x^{k-1/k}}} dx.$$

$$= 2a \frac{k}{k-1} \sqrt{1 - x^{k-1/k}} + C$$

Using (5) again, we get

$$-\int A.dp = 2a\frac{k}{k-1}\sqrt{1-\tau} + C \quad .. \quad .. \quad .. \quad (7)$$

Now, combining (6), (7), and (1), we obtain for the thrust

$$F = a\left\{\frac{\tau}{\sqrt{1-\tau}} + 2\frac{k}{k-1}\sqrt{1-\tau}\right\} + C \quad .. \quad .. \quad (8)$$

For $A_i \gg A_t$, we can use the following equations without introducing any great error:—

$$p_i = p_o \text{ and } A_t.p_o = A_i p_i$$

The thrust developed by the combustion chamber alone is then

$$F_{f-t} = A_i p_o - \int_{p_t}^{p_i} p.dA \quad .. \quad .. \quad .. \quad .. \quad .. \quad (9)$$

The thrust developed by the nozzle alone amounts to

$$F_{t-m} = \int_{p_m}^{p_i} p.dA \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad (10)$$

Finally, we have to subtract from the sum of (9) and (10) the amount

$$F_e = A_m.p_e \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad (11)$$

(Compare Sutton, "*Rocket Propulsion Elements*," pp. 12–13.)

Combining (9), (10), and (11), we have

$$F_a = F_{f-t} + F_{t-m} - F_e$$

$$= A_i.p_o - \int_{p_t}^{p_i} p.dA + \int_{p_m}^{p_i} p.dA - A_m.p_e \quad .. \quad .. \quad (12)$$

For combustion chambers of sufficient cross-section, we get from (4)

$$\underset{p_i \to p_o}{\text{Limit}}\ A_i p_i = \underset{x \to 1}{\text{Limit}}\ \frac{ax^{-1/k}}{\sqrt{1-x^{k-1/k}}} \quad .. \quad .. \quad .. \quad .. \quad (13)$$

and from (8)

$$\underset{p_i \to p_o}{\text{Limit}} \int_{p_t}^{p_i} p.dA$$

$$= a\left[\frac{\tau_i}{\sqrt{1-\tau_i}} + 2\frac{k}{k-1}\sqrt{1-\tau_i} + C\right.$$

$$\left. - \frac{\tau_t}{\sqrt{1-\tau_t}} - 2\frac{k}{k-1}\sqrt{1-\tau_t - C}\right] \quad .. \quad .. \quad .. \quad (14)$$

From the basic theory of thermodynamics, we know that

$$\tau_t = \frac{2}{k+1} \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad (15)$$

and it follows from this that

$$\frac{\tau_t}{\sqrt{1-\tau_t}} + 2\frac{k}{k-1}\sqrt{1-\tau_t} = 2\sqrt{\frac{k+1}{k-1}} \quad .. \quad .. \quad (16)$$

Combining (9), (13), (14), and (16), the thrust for chambers of sufficient cross-section becomes

$$F_{t-t} = \underset{x\to 1}{\text{Limit}} \left\{ a \left[\frac{x^{-1/k}}{\sqrt{1-x^{k-1/k}}} - \frac{x^{k-1/k}}{\sqrt{1-x^{k-1/k}}} - 2\frac{k}{k-1}\sqrt{1-\tau_i} + 2\sqrt{\frac{k+1}{k-1}} \right] \right\}$$

The first two terms of those between the brackets can be expressed as

$$\underset{x\to 1}{\text{Limit}} \left(x^{-1/k} \cdot \frac{(1-x)}{\sqrt{1-x^{k-1/k}}} \right) = \underset{x\to 1}{\text{Limit}} \frac{1-x}{\sqrt{1-x^{k-1/k}}} = 0$$

(One obtains the same result by differentiation of the nominator and denominator, by the method of l'Hôspital.)
The third term disappears as well, because

$$\underset{\tau\to 1}{\text{Limit}} \sqrt{1-\tau} = 0$$

There remains, therefore

$$F_{t-t} = 2a\sqrt{\frac{k+1}{k-1}} \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad (17)$$

From (10), (16), and (8), we have

$$F_{t-m} = a \left\{ 2\sqrt{\frac{k+1}{k-1}} - \frac{\tau_m}{\sqrt{1-\tau_m}} - 2\frac{k}{k-1}\sqrt{1-\tau_m} \right\} \quad (18)$$

Also, from (12), (17), (18), and (11), we have

$$F_a = a \left\{ 4\sqrt{\frac{k+1}{k-1}} - \frac{\tau_m}{\sqrt{1-\tau_m}} - 2\frac{k}{k-1}\sqrt{1-\tau_m} \right\} - A_m \cdot p_e \quad (19)$$

If (e.g. at high altitudes) p_e can be neglected, then we obtain

$$F_a = a \left\{ 4\sqrt{\frac{k+1}{k-1}} - \frac{\tau_m}{\sqrt{1-\tau_m}} - 2\frac{k}{k-1}\sqrt{1-\tau_m} \right\} \quad (20)$$

If, however, $p_e = p_m$ (which can occur, e.g. at the take-off of large rockets, or if variable nozzles are used), then we obtain from (2) and (4)

$$A_m \cdot p_e = A_m \cdot p_m = a \cdot \frac{p_m}{p_o} \cdot \frac{x_m^{-1/k}}{\sqrt{1-x_m^{k-1/k}}} = \frac{a\tau_m}{\sqrt{1-\tau_m}}$$

Combining this with (19) gives us the result

$$F_a = 2a \left\{ 2\sqrt{\frac{k+1}{k-1}} - \frac{\tau_m}{\sqrt{1-\tau_m}} - \frac{k}{k-1}\sqrt{1-\tau_m} \right\} \quad (21)$$

The equations (19), (20), and (21) allow a much quicker and easier calculation of the thrust than previous methods. The results, however, have to be multiplied by an efficiency factor of 95 to 99 per cent.

NOTES AND NEWS

Landing Spaceships

We have recently received a description from Mr. O. W. Neumark of an interesting radio approach device for aircraft, known as the Landing Guide, which would seem to have even more important applications for rockets.

The Guide consists of an attachment to the radio altimeter which operates a zero-reading pointer. By keeping this pointer zeroed, the pilot automatically follows the correct landing curve, which has been found by numerous tests to be expressed by the equation

$$\frac{dh}{dt} + kh = 0$$

where h is the height and k a constant. The vertical speed thus approaches zero at the point of contact.

Obviously such a device, coupled to the thrust control of a rocket, could be used for automatic stern-first landings—the only method of approach to airless bodies such as the Moon.

"Asking for the Moon"

It is to be hoped that many of our members were able to view the third of Arthur Clarke's television talks on the evening of July 18. Titled "Asking for the Moon," this half-hour programme covered much the same ground (though inevitably in rather less detail) as the same author's paper "Space Travel in Fact and Fiction," published in the September *Journal*. However, two additional items of great interest were included in the television broadcast. One was the complete sequence from the pre-war German film *Frau im Mond* ("The Girl in the Moon") showing the preparation for launching, and the actual take-off and early stages of flight, of the Oberth-designed spaceship. The other was a number of stills from the eagerly-awaited Hollywood film, *Destination Moon* (see also pages 241-4 of the September *Journal*).

Hayden Planetarium Interested in Space-Flight

An extremely interesting press release from the Hayden Planetarium, New York, gives an account of the showing of the film *Destination Moon* to a select audience of 200 in the Planetarium dome on June 20th. The original copy of the film has now been specially treated and will be preserved in the Planetarium to "Let future generations see what a pre-space-travel age had predicted."

It was stated by the producer, Mr. George Pal, that the Planetarium experts had worked closely with the film's technical staff in an attempt to make the space and lunar scenes as authentic as possible.

According to the acting chairman, Mr. Coles, the Planetarium is now inaugurating a search for all kinds of data and material dealing with space-travel. He asks for the co-operation of scholars, scientists and the general public in obtaining any type of literature, predictions, new scientific inventions and other material which might be displayed or kept in the archives of the Planetarium. He stated that the time is not far off when historians will be

avidly seeking this type of information, and the Planetarium is setting itself up as a centre and clearing house for information on space-travel.

A Large Cloud on Mars

We have recently heard from W. H. Haas regarding an unusual cloud on the south limb of Mars which was observed by Tsuneo Saheki, of Osaka, Japan, on January 16, 1950, and widely reported in the press a few days later. (See p. 142 of the May, 1950, *Journal*.)

The cloud was grey in colour, with faint yellow, but was not very brilliant. The geographic position of its centre on Mars was about longitude 202°, latitude 58° south, and its angular height above the surface 0.16″, i.e. more than 100 kms. The length of the cloud was about 1,500 kms.

Although Mr. Saheki has frequently recorded white or yellowish-white projections on Mars in the past, he has not seen such "a strange cloudy mass" since 1933. Its peculiar colour and dimness was reminiscent of E. M. Antoniadi's "cloud of volcanic ashes" discovered near Deucalionis Regio in 1909 and 1911 (*La Planéte Mars*, p. 21; Mars Report of 1911, *Memoirs B.A.A.*, Vol XX, Part IV, p. 126), and Saheki wondered if the present cloud was also composed of volcanic ashes.

On the day in question, Saheki was observing Mars from 1 h. to 5 h. J.S.T., and the cloud-bulge began to appear near 4 h. The seeing then, unfortunately, began to become poor and prevented further observations after 5 h. Further observations on following days were also impossible because of continuing bad weather.

Since the hypothesis that the cloud is of volcanic ash rests heavily upon its colour, visual observations with colour filters, or better still, photographs with filters, would be exceedingly important in such a case as this.

American Rocket Society

The latest *A.R.S. Journal* (No. 81, June, 1950) contains some interesting facts about the growth of what is now the largest rocket society in the world. The present membership is 1,002 (including 572 Active Members) which compares with a total of 318 (including 51 Active Members) in April, 1945.

About 40 per cent of the total membership is resident in and about New York, with a further 14½ per cent. in Southern California.

At present the A.R.S. also has seven Corporate Members who pay annual subscriptions of $250 (£90), and a further seven Affiliate Corporate Members, who pay annual subscriptions ranging from $100 to $400 (£35 to £140), in addition to 394 subscriptions from libraries and research organisations throughout the world.

The income of the Society for the year ended April, 1950, totalled £1,940, which yielded a surplus of £120 over expenditure, and brought the value of of the net assets to £5,100.

New Measurements of Pluto

On March 22, 1950, G. P. Kuiper had the rare opportunity of making visual observations of Pluto with the 200-inch telescope at Palomar. He found the diameter to be 0″.23, with an uncertainty of about 5 per cent. This

corresponds roughly to about 3,600 miles, which is nearly midway between the sizes of Mars and Mercury.

The reflectivity or albedo of the planet was found to be 17 per cent which compares with 15 per cent for Mars.

If a normal density is assumed, the mass of Pluto would be only 1/10th that of the Earth, whereas that indicated by the perturbations of Neptune is nine times this amount!

Space Travel Projectors

We have recently received from the Griffith Observatory, Los Angeles, some details of the "Space Travel Projectors" used there as an adjunct to the Planetarium. With these it is possible to arrange programmes on trips to the moon and visits to the outer planets—programmes which have proved the most popular the Planetarium has ever given, resulting in "full houses" and repeat performances almost every night.

A description of a typical show, as described in *The Griffith Observer*, is as follows:

"After an explanatory introduction, the audience watches the fading of a beautiful sunset. Gradually the stars appear, till by the time darkness has arrived, the watcher feels that he no longer is in a theatre but is looking at the actual sky on one of the clearest of nights. Soft music is heard till it is nearly time for sunrise . . . During the day the visitor travels to the earth's equator for the take-off to whatever part of space may be desired. On this day there is a discussion of the nature of space travel. The entirely different problems of a short lunar hop, of the much longer possible future trips to the planets, and the almost fantastic voyages which distant future generations conceivably may take to the stars are put into their proper relationships.

"The audience, leaving the earth for a 2,000,000,000 mile voyage, will see the earth diminish on the planetarium dome from 40 feet to 10 feet in diameter. Then, turning to the planet Jupiter, they will watch it brighten and gradually enlarge steadily until it has a diameter of more than 20 feet. Intricate details of its cloud-covered surface will gradually appear . . . From Jupiter we turn away to see the planet Saturn and watch it enlarge similarly, until it and its great family of rings appear as large as did the other planets. On the return we shall pass fairly close to Jupiter and shall watch it passing by the side of our vessel, whirling on its axis and presenting all sides to the audience. The tiny apparent disc of the sun at the great distances of these planets will be exhibited, and finally, when we turn toward the earth, we will see it grow again in size until at last we are ready to land."

The "Trip to the Moon" is described as follows:

"The trip starts from the equator of the earth, with the observing turret of the ship reproduced on the planetarium dome. The moon is seen at normal size through the 25-foot diameter window of the turret.

"Gradually the moon enlarges, with all its features startlingly sharp, till at last it fills the window. As we continue to approach, it enlarges even more until finally, the part seen through the 25-foot window is only a small fraction of the lunar surface.

"When we are within a few hundred miles of the surface, a "televisor screen" on the wall of the ship near the window is illuminated by an image of the moon with a spot of light on it, indicating the part of the moon which is visible through the window.

Planetarium instrument projected against image of Saturn.

"We now start travelling over the surface to study the most interesting of the features which pass rapidly below our 'observing window.' As we do this, the spot of light on the televisor follows the tour. Then after other features we return to earth, watching the moon recede till at last we view it once more from the surface of the earth . . . "

These descriptions are well calculated to induce a state of extreme frustration in the mind of any British reader, and underline once again the scandalous fact that there is not a single planetarium in this country. There is not the slightest doubt—as the experience of the Griffith Observatory has shown—that such an instrument would be a very sound investment—even as a business proposition—especially in these days of steadily mounting interest in astronautics and popular astronomy.

S.B.A.C., Farnborough, 1950

Rocket motors are no longer a novelty at the annual Society of British Aircraft Constructors' display, but considerable interest was aroused by the two units in this year's static exhibition. These were the de Havilland *Sprite* (described in the November, 1949 *Journal*) and an experimental Ministry of Supply rocket known as *Beta*. No details of this rocket were given: it is a hydrogen peroxide unit with two small combustion chambers, intended for the propulsion of a research aircraft. Little knowledge of rocket engineering is required to deduce that this aircraft, whatever it may be, could hardly accommodate a pilot larger than the well-known 23 in.-tall gentleman reputed to have been found in a crashed Flying Saucer. Various aircraft (notably the Avro 707 *Delta*, with its hair-raising landing using a tail-parachute for braking) hinted at the Shape of Supersonic Things to Come.

Visits to Hampstead Observatory

Arrangements have now been made for small groups of members to visit Hampstead Observatory, which is situated by White Stone Pond, on Hampstead Heath, five minutes' walk up Heath Street from Hampstead Underground

Station. The Observatory houses a 6-in. Cooke refractor, and members are reminded that the best time to observe the Moon is near the first quarter (age 5 to 10 days).

Anyone wishing to visit the Observatory should contact Mr. H. Wildey, F.R.A.S., 14, Savernake Road, Hampstead, N.W.3. (Gulliver 3721.)

Interplanetary Advertising

Londoners who find time to look at the many window displays in the West End will have noticed the appearance of the interplanetary theme for the first time.

A few weeks ago British Railways' Whitehall office produced an impressive tableau showing a rocket on the way to the Moon, with the caption "Excursions to the Moon? Well, not yet . . . but anywhere else. . . ."

This was followed by extensive "Destination Moon" publicity in the Strand and Oxford Street windows of Thomas Cook and Sons. Both displays were similar, and used large aluminium rockets, together with stills from the film. They were coupled with an assurance that, when the time came, Thos. Cook would be well to the fore. . . .

In addition, "Destination Moon" had a very extensive display in the Oxford Street window of the Rank Organisation. This also used a number of models and some stills.

There is also, at the moment of going to press, a spaceship rampant above the Cameo Cinema, Charing Cross Road, advertising the amazing epics of Flash Gordon. Of equally small scientific value but considerable advertising effectiveness is a space scene in the Piccadilly showrooms of Carreras Ltd. This shows a model of the Moon with a large arrow pointing downwards to a smaller Earth and the caption "Down to Earth with Carreras."

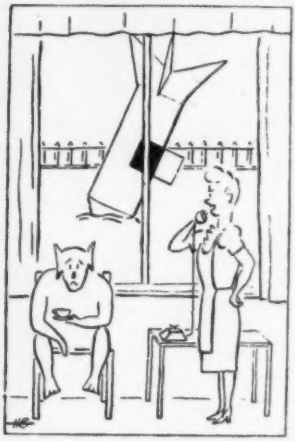
From the World's Press

Recent announcement of an agreement between the United States and the United Kingdom for an American rocket firing range, to be set up from Florida out across the Atlantic over the Bahamas, was swiftly followed by news of a flight by a V.2/WAC Corporal combination in this direction. Unlike the previous 250 mile vertical shot by such a two-step rocket, this one was designed to achieve maximum horizontal range, but the distance actually covered was not revealed.

* * * *

In the House of Commons defence debate on July 27, Mr. Winston Churchill had something to say about Russian progress with rocket missiles. The London *Daily Telegraph* reported him as stating that: "The Soviet Government picked up and developed all the Germans knew about this form of warfare. Peenemunde was in their hands, and all the great secrets of this new phase of warfare, on which Hitler set his final hopes, had been developed in five years of intensive study and production by the Russians (who) did not need to get to the coast to plant their batteries. Very long ranges were within the compass of these weapons."

* * * *



"Hello. Is that the Interplanetary Society?"

Reproduced by courtesy of the Editor of *Manchester Evening News.*

As a pleasant change from the usual variety, the August *Reader's Digest* reprints (from the Milwaukee *Journal*, which got it from the Racine, Wisconsin, *Journal-Times*!) the following story of "The Saucer that wasn't there" (like the little man upon the stair.—Ed.): "Racine police and deputies affirmed the story of a Racine man who reported that a 'mammoth spaceship' did not land on his farm north of the city. . . . In an interview with a reporter, the eye-witness gave the following account: 'I got out of bed and raised the window blind. Suddenly, it dawned on me that I couldn't hear or see a thing unusual outside. There was no ear-splitting crash nor any blinding flash of light. Looking toward the north, I could see no sign of a circular-shaped spaceship about 60 feet in diameter. It would have been about 14 feet high, I figure, if I had seen it.

" 'Pulling the blind down quickly, I climbed back into bed. I could see right off that no one would believe me, anyhow, so I'm not going to tell a living soul anything about it.' "

* * * *

World's records made by aircraft which are rocket-assisted will be officially recognised under new F.A.I. regulations after July 1. Presumably such a recognition has already been extended to the long-distance record, because the present holder (the U.S. Navy's Lockheed "Neptune," called "The Truculent Turtle") used J.A.T.O. on its departure from Australia across the Pacific.

* * * *

The *Hong-Kong Telegraph* tells us that the Allied Control Commissioner in the little Austrian town of Graz could hardly believe his ears when the local postmaster asked if he might have some gunpowder "for official use."

"It is for the rocket mail," he explained, and it transpires that two mountain villages near Graz have been enjoying a regular rocket mail service for the past 17 years, ever since it was first initiated by Fredrich Schmiedl. (See *Rocket Posts* in the July, 1949, *B.I.S. Journal*, pp. 133-6).

Apparently a precipitous mountain spur separates the two villages and makes normal road communication tediously slow.

* * * *

The *Scottish Daily Mail* carried an open invitation from the film company to all B.I.S. members north of the border to attend the premiere of "Destination Moon" at the Glasgow Gaumont on the morning of August 25—admission free on production of membership certificates. Hesitant Scots thinking of joining our Society might note this further proof of the incalculable benefits of membership!

On September 28, at 1.20 p.m., in the regular feature "Film Time" on the Light Programme, Arthur Clarke gave a talk on "Destination Moon" and "Rocketship XM." We suspect that B.B.C. regulations about discriminatory advertising cramped his style in saying what he *really* thought about the respective merits of the two films, but fairly long extracts from their sound-tracks were given, so that further comment was perhaps superfluous. One impression left on this listener by the broadcast was that Leith Stevens' music for "Destination Moon" really is rather fine: one notices it more when not simultaneously watching the picture, which is again a tribute to it as incidental music. We understand Columbia Records are to issue an album of discs.

* * * *

According to *Oil Power*, the house-magazine of the Socony-Vacuum Oil Co. in the States, a lunar trip should be possible in twenty-five years' time for a cost of 1,000,000,000 dollars.

This item gives point to another in the *Glasgow Bulletin*: sympathising with us because we need "several million quid" for a moon rocket, they offer the helpful suggestion . . . "couldn't (the B.I.S.) kid Clem into nationalising them, and then they'll get all they want ?"

* * * *

Most national newspapers recently carried the announcement that, as from September 4, Air Chief Marshal Sir Alec Coryton is to be Chief Executive (Guided Weapons) at the Ministry of Supply. It is stated that this important new post has been created to accelerate and co-ordinate all work on missile research, development, and production.

* * * *

Additions to the Lending Library

The following books have now been added to the Society's Lending Library and are available to Fellows holding Library tickets:—

L'Astronautique, by Lionel Laming (1949).
L'Astronomie, by Rudeaux and Vaucouleurs (1948).
Internal Ballistics of Rockets, by Wimpress (1950).
L'Humanité devant la Navigation Interplanétaire, by A. Ducrocq (1947).
The Nature of the Universe, by F. Hoyle (1950).

Olaf Stapledon

It is with deep regret that we record the death of one of our most distinguished members, Dr. Olaf Stapledon, who was a supporter of this Society since pre-war days and whose lecture *Interplanetary Man* (published in the *Journal* for November, 1948) was one of the highlights of the 1948-49 Session.

Olaf Stapledon first became famous through the publication of *Last and First Men* (1930), one of the greatest of all works of imaginative fiction. A history of the many races of man over the next 2,000,000,000 years, it is one of the few books that succeed in giving a real impression of the immensity of astronomical time and the possibilities that may lie before our species. The background of *Last and First Men* was merely the Solar System, but in *Star Maker* (1937), Stapledon attempted to conceive not only the history of

man and his handful of worlds but all intelligence in all universes. Some of these speculations were taken still further in *Darkness and the Light* (1942), memorable for its haunting final chapter in which the reality lying behind our cosmos is suggested.

Stapledon's pre-eminence as a science-fiction writer was due to the fact that, even when dealing with cosmic themes, he never lost his essential humanity. He could depict the rise and fall of interstellar empires, yet believed passionately in the value of the individual. His great skill at describing personal relationships was shown at its best in *Odd John* (1935) and *Sirius* (1944).

He devoted much of his energy to social causes and was a liberal in the finest sense of the word. In 1948 he attended the notorious Wroclaw conference and many will remember his balanced but spirited defence of western democracy, in the face of frequent interruptions, when the British delegation returned to London and gave its report. His insistence, on this occasion, upon the altruistic elements in American foreign policy required considerable moral courage, and his subsequent interrogation by the suspicious U.S. State Department on Ellis Island was one of those bureaucratic aberrations that sometimes make one despair for democracy.

Let us take leave of him in his own words:

> *Those dear delights, those modest powers, all that is the cherished me, I willingly let go. Others will repeat them, and some more splendidly. For me, when this tiresome ageing is fulfilled, the welcome end is sleep.*

PERFORMANCE CALCULATIONS OF SOME FUELS FOR ROCKET MOTORS

By Giorgio Nebbia

Assistente, Istituto di Merceologia Università degli Studi Bologna, Italy

For the planning of a better knowledge of the economic importance of rocket and ram-jet motors with non-gasoline fuels,[1] in the present paper, calculations are described for the theoretical performance of some mixtures of oxidant-fuel for rocket motors.

The calculations have been carried out by the recent theoretical method developed by Hottel and co-workers,[2,3] with the following main purposes:—

(*a*) To have a series of data calculated with the same method and therefore, fully comparable;

(*b*) To compare the thermodynamic characteristics calculated with Hottel's method and with the classical thermodynamic method; the comparision is possible for 75 per cent. ethyl alcohol[4,5] and for gasoline,[4] whose performance has been already calculated by the classical thermodynamic method;

(*c*) To suggest a method of comparison of the rocket fuels in terms of the characteristics of their mixture with the same oxidiser, e.g. liquid oxygen.

In the present paper, there have been examined: 75 per cent. ethyl alcohol, 100 per cent. ethyl alcohol, diethyl ether, propane, butane, gasoline (C_8H_{16} average composition). The results are collected in the Figs. 1–6 and in Table I, in which the comparison is made at an approximately "equal cost" basis, the liquid oxygen being the component that mainly determines the price of the mixture.

TABLE I

CALCULATED FOR AN EXPANSION RATIO OF 20

(Combustion chamber pressure = 20 atm., nozzle exit pressure = 1 atm.)

Mixture	Mixture ratio oxide/fuel	Exhaust velocity (ft./sec.)	Specific thrust (secs.)	T = Flame temperature (degrees K)	MW = Mean mol. weight	γ = Specific heat ratio	Specific gravity of the mixture
Liquid oxygen and:							
100 per cent. Ethyl alcohol	1·5/1·0	7,800	241	3,100	23	1·18	0·99
75 per cent. Ethyl alcohol	1·5/1·0	8,050	250	3,150	22	1·20	0·96
Diethyl ether ..	1·5/1·0	8,220	255	3,100	20	1·22	0·92
Propane	1·5/1·0	7,310	227	2,150	16	1·27	0·86
Butane	1·5/1·0	7,410	230	2,300	16	1·28	0·88
Gasoline C_8H_{16} ..	1·5/1·0	7,240	225	2,500	17	1·27	0·94

Keeping in mind the well-known ideal characteristics of a rocket motor fuel, the following considerations are suggested from such results:—

(*a*) The very good performance of ethyl alcohol fully justifies the favour this fuel has encountered in rocket researches;

(*b*) The presence of water in the ethyl alcohol does not lower its good performance, while it results in a cost much lower than that of 100 per cent. ethyl alcohol;

(*c*) Diethyl ether—never considered until now as a rocket fuel as far as is known from the literature—possesses as good performance as ethyl alcohol;

(*d*) Hydrocarbons appear to possess less good characteristics by comparison with ethyl alcohol and diethyl ether; this should suggest a trial of the last fuels in ram jet motors, thermodynamically similar to rocket motors, instead of gasoline[6] or propane.[7]

BIBLIOGRAPHY

(1) G. Nebbia, *Rivista di Politica Economica*, **40**, 225 (1950).
(2) H. C. Hottel, G. C. Williams and C. N. Satterfield, *Trans. Am. Soc. Mech. Engrs.*, **70**, 667 (1948).
(3) H. C. Hottel, G. C. Williams and C. N. Satterfield, *Thermodynamic Charts for Combustion Processes, Parts I and II*, John Wiley & Sons, Inc., New York, 1949.
(4) M. J. Zucrow, *J. Am. Rocket Soc.*, **72**, 26 (1947).
(5) G. P. Sutton, *Rocket Propulsion Elements*, John Wiley & Sons, Inc., New York, 1949.
(6) J. M. J. Kooy and J. W. H. Uytenbogaart, *Ballistics of the Future*, McGraw-Hill Book Co., Inc., New York, 1946.
(7) Editorial, *J. Am. Rocket Soc.*, **73**, 45 (1948).

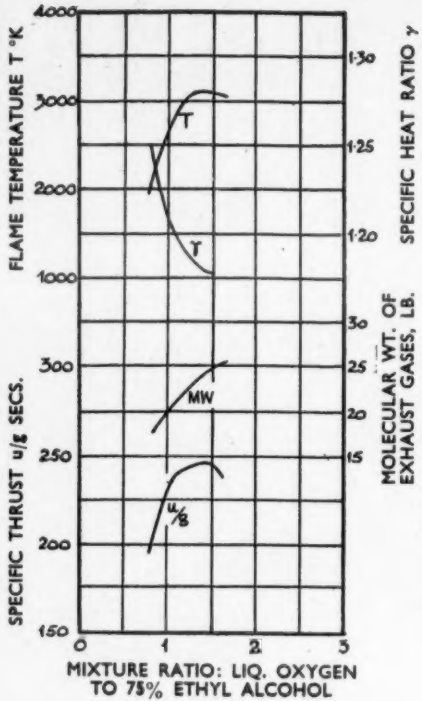


FIG. 1

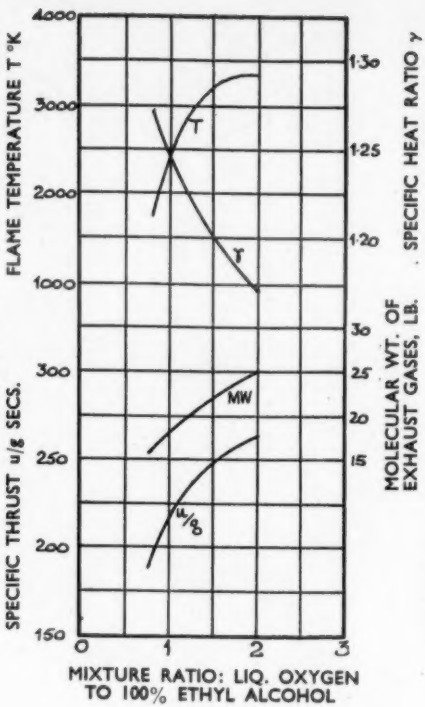


FIG. 2

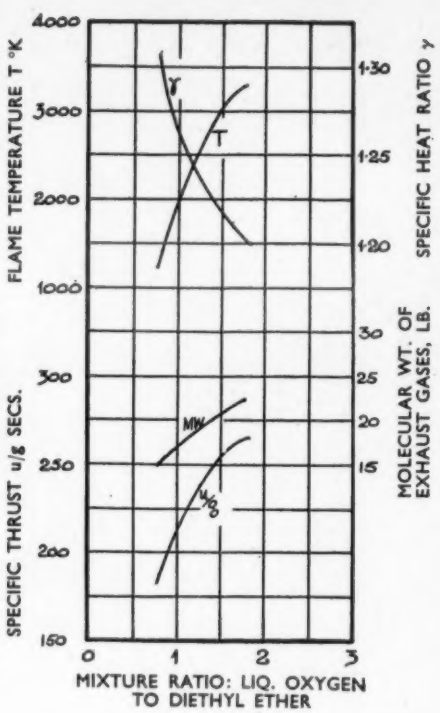


FIG. 3

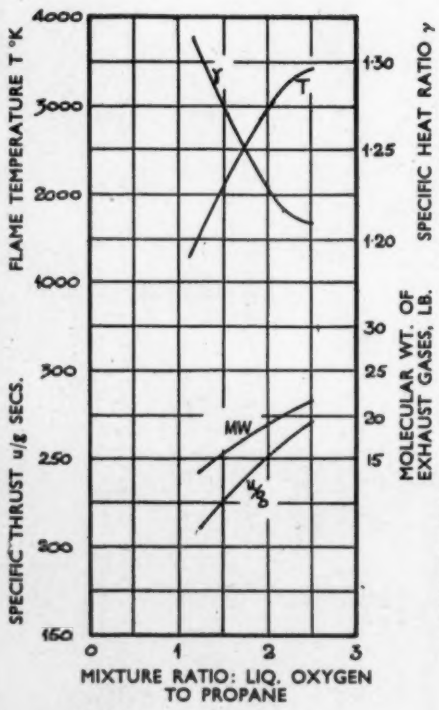


FIG. 4

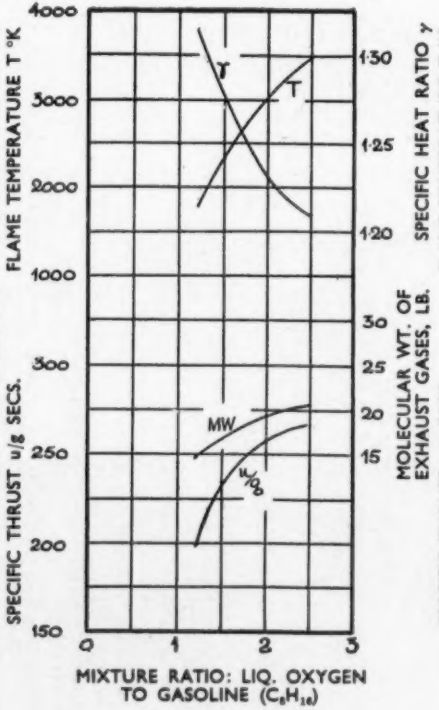


FIG. 5

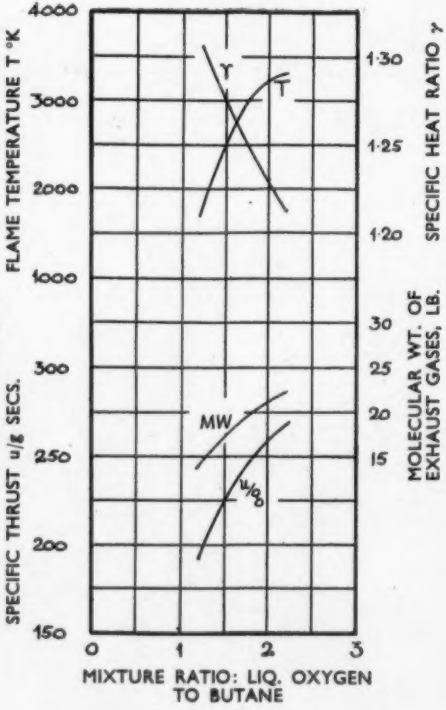


FIG. 6

ABSTRACTS

Edited by J. HUMPHRIES

Abbreviations of titles of journals were given in the May, 1950, issue of the *Journal* and addenda appeared in the July and September issues. The following is a further addendum to the list.

Autom. Ind.	Automotive Industries.
CADO Techn. Dig.	CADO Technical Digest.
Chem. Engng. Progr.	Chemical Engineering Progress.
Elektrotech. Z. (ETZ).	Elektrotechnische Zeitschrift.
J. Atmos. Terrestr. Phys.	Journal of Atmospheric and Terrestrial Physics.
J. Franklin Inst.	Journal of the Franklin Institute.
J. Phys. Coll. Chem.	Journal of Physical and Colloid Chemistry.
Mater. and Meth.	Materials and Methods.
Mech. Engng. N.Y.	Mechanical Engineering.
Metal Progr.	Metal Progress.
R.A.F. Quart.	R.A.F. Quarterly.
Riv. Pol. Econ.	Rivista di Politica Economica.
Sci. News.	Science News.
Techn. Autom.	Technique Automotive.

Many of the Abstracts noted are available on loan to members resident in the British Isles. Requests should be addressed to J. Humphries, 97, Churchill Avenue, Southcourt, Aylesbury, Bucks.

AIRCRAFT

The first rocket plane. H. K. KAISER. *Rocketscience*, **4**, 37-9 (*June*, 1950).

ASTRONAUTICS

Will we penetrate interplanetary space? M. REICHEL. *Techn. Autom.*, **40**, 30-2 (1949). (*In French.*)

The use of the space station for space navigation. L. J. GRANT. *J. Space Flight*, **2** (3), 1-5 (*March*, 1950).

The proper military use of the space station. W. PROELL. *J. Space Flight*, **2** (3), 5-8 (*March*, 1950).

Further studies in space station economics. L. J. GRANT. *J. Space Flight*, **2** (5), 1-7 (*May*, 1950).

Space-travel research. H H. KÖLLE. *Monatszirkulär der Schwäbischen Sternwarte* (*May*, 1950). (*In German.*)

An earth-moon orbit. M. CONLEY. *J. Space Flight*, **2** (6), 1-7 (*June*, 1950).

Energy problems of space-flight. H. GARTMANN. *Weltraumfahrt* (3), 62-7 (*June*, 1950). (*In German.*)

Space navigation. H. H. KÖLLE. *Weltraumfahrt* (3), 54-7 (*June*, 1950). (*In German.*) A survey of possible methods.

Interplanetary flight. A. V. CLEAVER. *Aircraft*, **28**, 12-15, 46 (*July*, 1950). General review of rocketry and space-flight.

The space station. H. GARTMANN. *Die Umschau* (15), 465-7 (1st *Aug.*, 1950).

Rockets and space-flight in the film. *Weltraumfahrt* (4), 86-91 (*Aug.*, 1950). (*In German.*)

Flight path determination in space. Pt. 1. W. SCHAUB. *Weltraumfahrt* (4), 73-7 (*Aug.*, 1950). (*In German.*) Basic astronomical principles.

ASTRONOMY

Does vegetation exist on the planet Mars? G. A. TIKHOV. *Priroda* (7), 3 (*July*, 1949). (*In Russian.*)

BIOLOGY AND MEDICINE

Report on the 1950 Symposium on Space Medicine. J. P. HENRY. *J. Space Flight*, **2** (5), 8-11 (*May*, 1950). Abstracts of papers read at the Symposium which was given at the University of Illinois.

Effects of gravity on man. J. SCHNEIDER. *Weltraumfahrt* (4), 82-5 (*Aug.*, 1950). (*In German.*)

MATERIALS

Initial investigation of carbide-type ceramal of 80 per cent. titanium carbide plus 20 per cent. cobalt for use as gas-turbine blade material. C. A. HOFFMAN, G. M. AULT and J. J. GANGLER. *NACA Tech. Note No.* 1836 (*March*, 1939).

Metals and refractories combined in high-temperature structural parts. J. B. CAMPBELL. *Mater. and Meth.*, **31**, 59-63 (*May*, 1950). A review of ceramals covering oxide-metal combinations, boride-metal combinations and cemented carbides.

MISCELLANEOUS

Facts about the German secret weapons research station, Peenemunde. *Flugwelt* (3 and 4) (1950). (*In German.*)

The Peenemunde rocket centre. Pt. 2. K. A. EHRICKE. *Rocketscience*, **4**, 31-4 (*June*, 1950). A general review of the Peenemunde rocket projects.

A history of the Detroit Rocket Society. A. J. ZAEHRINGER. *Rocketscience*, **4**, 40-4 (*June*, 1950).

PHYSICS

Optical methods for the determination of flame temperatures. S. S. PENNER. *Amer. J. Phys.*, **17**, 422-9, 491-500 (*Oct. and Nov.*, 1949).

Sweat cooling. N. P. W. MOORE and P. GROOTENHUIS. *The Engineer*, **199**, 230-1 (*24th Feb.*, 1950). Brief review of the mechanism of sweat cooling and consideration of the available experimental data with particular reference to the use of air in gas turbines.

Sweat cooling. H. L. WHEELER and P. DUWEZ. *Autom. Ind.*, **103**, 40, 110, 112 (*15th July*, 1950).

PROJECTILES

Summary report on A-4 control and stability. H. FRIEDMAN. *U.S.A.F., Summary Rep. No. F-SU-2152-ND*, 247 pp. (*June*, 1947) (44 refs.).

The German guided missile X-4. F. E. PATTON. *U.S.A.F., Summary Rept. No. F-SU-2131-ND*, 116 pp. (*June*, 1947).

Summarises available data with details of control, radio, airframe, propulsion, production, laboratory calculations, and experiments. History of Dr. Ing. Max Kramer, chief designer, is recorded, as well as other personnel connected with the X-4 project. Reports covers specifications, performance data, warhead and fuse and launching devices. Profusely illustrated. (29 refs.)

Vertical climb of a controlled flying body. *U.S.A.F. Trans. No. F-TS-2637-RE*, 6 pp. (*Aug.*, 1947 [*Göttingen, Technische Hochschule, ZWB/THG/41/9*].

Calculations of the gyropilot made by Kreiselgeraete. FREDERICK. *U.S.A.F., Trans. No. F-TS-2102-RE*, 8 pp. (*Aug.*, 1947) [*Peenemunde, ZWB/PA/86/14* (*Nov.*, 1939)].

Test firing of R-L guided missile "Rheintochter." FRICKE. *U.S.A.F., Trans. No. F-TS-3262-RE*, 2 pp. (*Aug.*, 1947) [*PM/Rtr/PS/P/8* (*July*, 1944)].

Investigation of stability range for guided missiles with control position coordination. R. GEBERT. *U.S.A.F., Trans. No. F-TS-112-RE*, 57 pp. (*Aug.*, 1947) [*Peenemunde, ZWB/PA/86/43* (*Sept.*, 1940)].

Stability of the A-5 ground-to-ground guided missile about its trajectory. LUDWIG. *U.S.A.F., Trans. No. F-TS-1111-RE*, 25 pp. (*Aug.*, 1947). [*Peenemunde, ZWB/PA/86/47* (*Sept.*, 1940).]

Stability of oscillations perpendicular to the plane of the trajectory for a guided missile equipped with Möller control apparatus. LUDWIG. *U.S.A.F., Trans. No. F-TS-2112-RE*, 25 pp. (*Aug.*, 1947). [*Peenemunde, ZWB/PA/86/49* (*Sept.*, 1940).]

Lateral control with gyro-pendulum for A-5 missile. EICHLER. *U.S.A.F., Trans. No. F-TS-2111-RE*, 8 pp. (*Jan.*, 1948). [*Peenemunde, ZWB/PA/86/45* (*Sept.*, 1940).]

Application of locus-curve theory to control problems. LUDWIG. *U.S.A.F., Trans. No. F-TS-2131-RE*, 41 pp. (*Jan.*, 1948). [*Peenemunde, ZWB/PA/86/85* (*20th June*, 1941).]

Correction of roll developing shortly after launching of missile. LUDWIG. *U.S.A.F., Trans. No. F-TS-2136-RE*, 18 pp. (*Jan.*, 1948). [*Peenemunde, ZWB/PA/86/91* (*Sept.*, 1941).]

Report of evaluation of a German battery for use in guided missiles. G.E.C. RES. LAB. *U.S.A.F., Tech. Rep. No. F-TR-2117B-ND*, 24 pp. (*Feb.*, 1948).

Heating of bulkhead ribs through outer surface of guided missiles. HASE. *U.S.A.F., Trans. No. F-TS-2428-RE*, 8 pp. (*Feb.*, 1948). [*Hannover, Technische Hochschule, ZWB/TH Hann/47/14* (*May*, 1942).]

Calculations of skin temperatures of the A-4 guided missile. HILD. *U.S.A.F., Trans. No. F-TS-3109-RE*, 8 pp. (*Feb.*, 1948). [*Peenemunde, ZWB/PA/68/9* (*Nov.*, 1940).]

Study of the lateral guide-beam control of the V-2 missile. SCHUBERT and SPEHR. *U.S.A.F., Trans. No. F-TS-2122-RE*, 16 pp. (*Feb.*, 1948). [*Peenemunde, ZWB/PA/86/74* (*3rd Feb.*, 1941).]

Guide-beam control constants for A-4 rocket variable with time. SCHUBERT, SPEHR and HOELKER. *U.S.A.F., Trans. No. F-TS-2784-RE*, 23 pp. (*Feb.*, 1948). [*Peenemunde, ZWB/PA/86/123*(*April*, 1943).]

Methods for recovery of guided missiles. K. HIPP. *U.S.A.F., Trans. No. F-TS-3087-RE*, 35 pp. (*March*, 1948). [*Stuttgart, Forschungsanstalt Graf Zeppelin, ZWB/UM/709* (*Dec.*, 1942).]

A heliographic attitude recorder for missiles. W. B. KLEMPERER. *Navigation*, **2**, 49-54 (*Sept.*, 1949). [*Abs.* in *Aero. Engng. Rev.*, **9**, 64 (*March*, 1950).]

Second Viking will soon be ready to explore conditions in air above stratosphere. *The Martin Star*, **8**, 10-12 (*Aug.*, 1949).

How good are guided missiles? G. P. SUTTON. *Flying*, **45**, 18-20, 70, 71 (*Sept.*, 1949).

First supersonic guided missile. NAUGLE. *Air Trails*, 24 (*Oct.*, 1949). Description of Wasserfall.

How to shoot a 5-ton sky-rocket. *Pop. Sci. Mon.*, 129 (*Nov.*, 1949). Non-technical article on Viking.

Exterior ballistics of rockets in space with constant gravitational field. P. BLANC. *Mém. Artill. Franc.*, **24**, 7-158 (1950). (*In French.*)

The first chapter deals with simple rectilinear trajectories with zero gravitational force in order to state the characteristics of the movement of a body propelled by reaction. Vertical trajectories are next dealt with and then general expressions are deduced for non-vertical trajectories. These are examined in more detail and expressions obtained for the cases where the line of thrust is tangential to the line of flight and where it makes a constant angle with the vertical, i.e. no turning movement is applied to the rocket. In all cases both constant acceleration and constant thrust are considered. The expressions are obtained in non-dimensional form and a series of curves and tables enable trajectories to be quickly obtained for any of the cases considered for rockets with mass ratios between 1 and 10 and thrust to initial mass ratios between 1 and 5.

Long-range ballistics. M. GARNIER. *Mém. Artill. Franc.*, **24**, 159-98 (1950). (*In French.*)

The destroyer aircraft with satellite rockets. *R.A.F. Quart.*, 13 (*Jan.*, 1950).

High altitude rocket tail section found. *CADO Techn. Dig.*, 6 (*March*, 1950).

Ship fires rocket in Alaskan waters. *CADO Techn. Dig.*, 8 (*March*, 1950).

Anti-bomber rocket missiles. E. F. CHANDLER. *Aero Dig.*, **60**, 100-2 (*April*, 1950).

Lark production shows missile progress. D. A. ANDERTON. *Aviation Wk.*, **52**, 12-13 (*22nd May*, 1950). Short description of structural design, motor, avionic equipment and method of launching.

The electro-technics of the V-2. F. KIRSCHSTEIN. *Elektrotech. Z. (ETZ)*, **71**, 281-7 (*22nd May*, 1950.) (*In German.*)

After a brief description of the flight-path and steering requirements of the V.2 rocket the "beam steering" (Leitstrahl) method of radio control is described. This method was later superseded by a self-contained auto-pilot in the rocket. Also described is the method of velocity determination by means of the Doppler principle. This too was later replaced by a mechanically integrating accelerometer.

RADIO AND ELECTRONICS

Description of an automatic data-analyzing machine. B. S. BENSON. *Mech. Engng., N.Y.*, **72**, 285-8 (*April*, 1950).

For analyzing bar-graph records such as are obtained from certain types of telemetering equipment. Twenty-eight channels can be analyzed and 40 points plotted per minute with an accuracy better than $\pm \frac{1}{2}$ per cent. of full-scale deflection.

Rockets and radio-transmission. P. GOERCKE. *Weltraumfahrt* (3), 49-53 (*June*, 1950). (*In German.*)

Investigation of radio attenuation caused by ionisation in rocket flames. Degrees of ionisation of gases found by radar tests were much higher than previously found either experimentally or theoretically, due to non-equilibrium conditions in the flame at very high temperatures and velocities. Self-transmission from flames was found to be due to "plasma vibration" of the electrons and positive and negative ions. Attenuation was found to be effective only at distances behind the nozzle up to twelve times the venturi exit diameter. Choice of frequency for radio equipment depends on the duty to be performed. For radar tracking purposes a frequency to give the maximum reflection from the flame should be used in order to obtain the strongest signal, but for control or telemetering a higher frequency must be used to reduce signal attenuation.

Communication between heavenly bodies. K. O. KIEPENHEUER. *Weltraumfahrt* (3), 57-9 (*June*, 1950). (*In German.*) Considers radio communication; a 1,000 kW transmitter with a 1 deg. beam angle and 2 metre wave-length could send a strong signal to Proxima Centauri.

ROCKET MOTORS

How the rocket exhaust behaves. *Air Trails Pict.*, 18 (*Nov.* 1949).

Metallographic study of heat flow in rocket motor walls. M. C. SANZ and H. C. IHSEN. *Metal Progr.*, **56**, 685-7 (*Nov.*, 1949).

This new method depends on the fact that part of the chamber wall is raised above the transformation point during firing. A micrograph shows the point of demarcation and the temperature at this point is therefore known. The coolant wall temperature is measured and the gas side temperature and heat flow can be calculated.

Instruction and research in jet propulsion. L. CROCCO. *J. Amer. Rocket Soc.* (80), 32-43 (*March*, 1950).

Organisation of The Daniel and Florence Guggenheim Jet Propulsion Centre within the aeronautical engineering department at Princeton University is discussed. Research facilities are described and several programmes of research are enumerated. In the second half of the paper, the author relates pioneer experimental work in Italy beginning in 1927 in which he collaborated. This covers development of solid-propellant rockets, bipropellant engines and researches on monopropellants.

Rockets. D. HURDEN. *Sci News* (15), 72-85 (*March*, 1950). A general introduction.

Problems of combustion. Liquid-propellant rocket motors. R. B. CANRIGHT. *Chem. Engng. Progr.*, **46**, 228-32 (*May*, 1950).

This paper first describes the way in which a liquid-propellant rocket motor works. Rocket performance and design parameters are defined. Chemical reactions in the rocket are discussed, on the basis of present semi-empirical knowledge. Influence of the injector, chamber and nozzle upon combustion are mentioned. Finally, use of non-carbonaceous fuels is emphasised and, as an example, experimental data from the systems ammonia/oxygen and aniline/R.F.N.A. are discussed.

Heat-transfer problems in liquid-propellant rocket motors. R. GORDON. *J. Amer. Rocket Soc.* (81), 65-78 (*June*, 1950).

The present-day high-performance rocket motor, with its extremely high heat-flux rates and combustion temperatures, presents many new heat-transfer problems which are beyond the range of previous work and not adequately covered by existing theory. Some of the basic problems are discussed, and possible reasons for the inability of conventional formulas and theories to correlate actual rocket-motor heat-transfer data are given. Several techniques for handling high heat-flux rates and their applicability are mentioned.

The ideal impulse. H. OBERTH. *Rocketscience*, **4**, 26-30 (*June*, 1950). Translation from "Wege zur Raumschiffahrt."

Application of near-equilibrium criteria during adiabatic flow to representative propellant systems. S. S. PENNER. *J. Franklin Inst.*, **249**, 441-8 (*June*, 1950).

Near-equilibrium criteria for chemical reactions during adiabatic flow through a nozzle are summarised. These criteria are then applied to two representative chemical systems.

It is shown that the adiabatic expansion of the combustion products produced in the hydrogen-fluorine motor using the reactants in stoichiometric proportions should occur under conditions very closely approximating thermodynamic equilibrium. One of the near-equilibrium criteria is modified and used to demonstrate the departure from thermodynamic equilibrium for the decomposition of nitric oxide. This study of the equilibrium involving nitric oxide, nitrogen, and oxygen suggests the occurrence of practically frozen flow below a certain temperature, a result which is in agreement with the conclusions reached by a detailed numerical calculation.

Fundamental problems in rocket research. M. SUMMERFIELD. *J. Amer. Rocket Soc.* (8), 79-98 (*June*, 1950).

Presents various fundamental problems that have arisen in connection with recent advances of rocket technology and indicates in some cases the directions in which solutions might be found. The whole realm of rocketry is not covered and certain problems in the fields of combustion processes, convective heat transfer in liquids, radiative heat transfer, transport properties and flow through exhaust nozzles are considered. (39 refs.)

Instruction and research at the Daniel and Florence Guggenheim Jet Propulsion Centre. H. S. TSIEN. *J. Amer Rocket Soc* (81), 51-64 (*June*, 1950). [*Shortened version published as* Research in rocket and jet propulsion. *Aero. Dig.*, **60**, 120-2, 124-5 (*March*, 1950).]

After a short description of the Guggenheim Jet Propulsion Centre the rest of the paper is devoted to a review of the problems in rocketry, including materials, heat transfer and combustion. Finally, performance figures for a 3,000-mile range rocket liner are given. Salient features include:—propellants, liquid hydrogen with either liquid oxygen or liquid fluorine : gross weight 96,500 lb. : maximum velocity 9,140 m.p.h. : flight duration less than one hour. (14 refs.)

Rocket propulsion. J. GEERTSMA. *Avia*, **9**, 266-9 (1*st July*, 1950). (*In Dutch.*)

The calculation of the volume of rocket combustion chambers. J. HIMPAN. *Aircraft Engng.*, **22**, 191-3 (*July*, 1950).

It is shown that there is available generally valid theoretical and practical relationships between the combustion chamber volume and any desired combustion pressure, mass flow, fuel and combustion chamber shape.

RMI rocket test stand simulates flight attitudes. *Aviation Wk.*, **53**, 33 (14*th Aug.*, 1950).

Power gas generating devices. J. TAYLOR, A. C. HUTCHISON and I. EAGELSTON. *Brit. Pat. No.* 627,727. (1949). Pyrotechnic compositions for producing gas for expelling rocket propellants.

ROCKET PROPELLANTS

Nitrogen tetroxide as rocket propellant. H. ROSS. *Science News Letter*, **56**, 377 (1949).

The economic importance of fuels with respect to modern methods of propulsion. G. NEBBIA. *Riv. Pol. Econ.*, **40**, 225-9 (*Feb.*, 1950). (*In Italian.*) (30 refs.)

Hydrogen peroxide as a propellant. R. BLOOM, N. S. DAVIS and S. D. LEVINE. *J. Amer. Rocket Soc.* (80), 3-17 (*March*, 1950).

The latest information on the properties of 90 per cent. H_2O_2 which are pertinent to the rocket engineer are summarised. Handling and storage characteristics are described, and compared with those of other liquid oxidisers. Finally, its potential as an oxidiser in combination with carbon or nitrogen bearing fuels and as a monofuel are outlined and critically discussed.

Nitrogen tetroxide as an oxidizer in rocket propulsion. D. H. ROSS. *J. Amer. Rocket Soc* (80), 24-31 (*March*, 1950).

Physical and chemical properties, methods of preparation and handling, and some typical reactions of nitrogen tetroxide are discussed, with emphasis on those of greatest interest to rocket engineers. (16 refs.)

Handling of liquid oxygen. G. E. SIMPSON. *J. Amer. Rocket Soc.* (80), 18-23 (*March*, 1950). Reviews experience and states principles pertinent to oxygen handling and equipment design.

Nitrogen dioxide derivatives in rocket fuels. N. BOWMAN. *J. Space Flight*, **2** (4), 1-4 (*April*, 1950).

Physical characteristics of nitrogen base oxidants are given with theoretical performances with various fuels. It is concluded that no oxidant in this class rivals oxygen in performance.

Symposium on kinetics of propellants. Introductory remarks. R. E. GIBSON. *J. Phys. Coll. Chem.*, **54**, 847-53 (*June*, 1950).
Review of the problems connected with solid propellants.

The mechanism of the burning of double-base propellants. B. L. CRAWFORD, C. HUGGETT and J. J. MCBRADY. *J. Phys. Coll. Chem.*, **54**, 854-62 (*June*, 1950).
The results of experiments dealing with various aspects of the burning of double-base powders at pressures between 10 and 6,500 lb./in². are described. Based on these results a qualitative picture of the burning process is presented. The mechanism is shown to account for the observed effects of various compositional changes on the burning rate and the pressure dependence of the burning rate.

An hypothesis for propellant burning. R. E. WILFONG, S. S. PENNER and F. DANIELS. *J. Phys. Coll. Chem.*, **54**, 863-72 (*June*, 1950).
An hypothesis is offered for the burning of propellants in which it is assumed that the rate-determining step is the breaking of the O—N bonds at the extreme surface of the propellant. Experimental evidence is offered for the high surface temperature and for an activation energy of 46,700 cal./mole. Applying the simple formula for a unimolecular bond-breaking process, calculations are made for the linear burning rate and for the influence of the initial temperature of the propellant.

Thermal theory of ignition of solid propellants. J. H. FRAZER and B. L. HICKS. *J. Phys. Coll. Chem.*, **54**, 872-6 (*June*, 1950).
Preliminary results of calculations are given of temperature as a function of position and time for a simple thermal model of ignition for which the external heating rate conforms approximately to the course of heating by the igniter of the propellant in a rocket.

Determination of the thermal structure of a combustion wave by fine thermocouples. R. KLEIN, M. MENTSER, G. VON ELBE and B. LEWIS. *J. Phys. Coll. Chem.*, **54**, 877-84 (*June*, 1950).
The method involves the use of fine thermocouples in conjunction with a string galvanometer. Temperature - time curves together with measurements of burning velocity allow determination of the temperature - distance curves. The results of measurements with nitrocellulose strands clearly show the effects of pressure and temperature distribution in the wave.

The theory of the burning of double-base rocket powders. O. K. RICE and R. GINELL. *J. Phys. Coll. Chem.*, **54**, 885-917 (*June*, 1950).
A theory is developed in which flow of heat from the reacting gases beyond the burning surface to that surface plays an important role. The theory serves to correlate the effect of pressure and temperature on the burning rate, the comparative behaviour of the flame and its distance from the surface in ordinary double-base powders and in powders containing a catalyst, and the effect of coolants on the burning rate. (21 refs.)

Radiation effects in propellant burning. W. H. AVERY. *J. Phys. Coll. Chem.*, **54**, 917-28 (*June*, 1950).
An examination is made of the factors which can affect the shape of the pressure-time curve of a rocket fired statically under standard conditions. The radiation effect is studied in some detail.

A physical theory of burning of double-base rocket propellants, I. R. G. PARR and B. L. CRAWFORD. *J. Phys. Coll. Chem.*, **54**, 929-54 (*June*, 1950).
Discussion of a theory which assumes that burning is a stepwise process. The results indicate that the observed low-pressure drop-off of burning rate curves can be accounted for on the basis of a solid-phase reaction zone of finite thickness. Agreement is obtained with Rice and Cinell's zero-diffusion results for high pressures.

Rocket tests with hydrogen and oxygen. K. B. SCHOENENBERGER. *Weltraumfahrt* (4), 80-1 (*Aug.*, 1950). (*In German.*)
Description of tests with gases using the gases and internal water film for cooling.

UPPER ATMOSPHERE

Chemical analysis of stratosphere samples from 50 and 70 km. height. K. F. CHACKETT, F. A. PANETH and E. J. WILSON. *J. Atmos. Terrestr. Phys.*, **1**, 49-55 (1950).
Samples of air from heights ranging from 50 to 70 km. obtained by means of the V.2 have been tested for oxygen, argon, neon, and helium. Except in the case of oxygen the results show that the composition of the air at these heights is not appreciably different from that at ground level. A large deficit of oxygen was found but this is attributable to the method of sampling.

The cosmic-ray intensity above the atmosphere at the geomagnetic equator. J. A. VAN ALLEN and A. V. GANGNES. *Phys. Rev.*, **78**, 50-2 (*1st April*, 1950).
By means of G-M counter telescopes in an Aerobee sounding rocket fired from the USS Norton Sound, total charged particle cosmic-ray intensity above the atmosphere has been measured at the geomagnetic equator.

Stars and heavy primaries recorded during a V.2 rocket flight. H. YAGODA, H. G. DE CARVALHO and N. KAPLAN. *Phys. Rev.* **6**, 765-7 (*15th June*, 1950).

Dynamic probe measurements in the ionosphere. A. REIFMAN and W. G. DOW. *Phys. Rev.*, **76**, 987-8 (*1st Oct.*, 1949).
Determination of ion density and electron energy distribution with V.2 rocket.

REVIEWS

Aviation Medicine in its Preventive Aspects: An Historical Survey

(By John F. Fulton, O.B.E., M.D., D.Sc. Pp. viii + 174. 43 figs. Geoffrey Cumberlege, Oxford University Press, London, New York, Toronto. 1948. Price 12s. 6d.)

This book does not cover the whole field of Aviation Medicine, because, as the author explains, that would be more than one man's job. But his five chapters deal with the effects of a reduction of external air pressure, either gradual or sudden, and of accelerations, including sudden deceleration in crashes. Most of it, therefore, has a bearing on space flight, though the balancing mechanisms of the inner ear are not dealt with. Though the author is a Professor at Yale University, the book is a reprint of a lecture course delivered at the London School of Hygiene and Tropical Medicine during 1947. It is well written and most interesting.

The first chapter leads up to a description of "Operation Everest," in which four young men spent a month being artificially acclimatised in a decompression chamber, after which they could stand an altitude of 29,025 ft. (i.e. its pressure equivalent) for 21 minutes without extra oxygen, 50,225 feet for a few minutes on 100 per cent. oxygen, and 45,000 feet for over an hour, also on pure oxygen.

Chapter II deals with decompression sickness caused by rapid ascent to a high altitude. Although due to nitrogen bubbles in the tissues, it takes a substantial fraction of an hour to develop, but it can be brought on instantaneously at altitude by taking exercise, apparently because this increases the carbon dioxide in the blood. It may be prevented altogether by breathing oxygen for four hours beforehand. Individuals vary greatly in susceptibility.

Explosive decompression, such as might happen if a meteor penetrates a space ship, is discussed in Chapter III. It is comforting to learn that a sudden release of outside pressure does not immediately fill the body with a spate of nitrogen bubbles, though it may, if severe, cause blood vessels to burst in the lungs. Animal experiments have shown that the lungs cannot pick up oxygen at any height above 52,500 feet, and the animal must be re-compressed within 30 seconds in air or 60 seconds in oxygen, in order to survive. An unexpected finding is that, if decompression is instantaneous, the animal can only bear expansion of its internal gases to twice their volume, but they can expand four times if decompression lasts one-tenth of a second, without causing immediate death.

The fourth chapter gives many figures of the amount of g the human frame can stand, the maximum being more than 12 g in the lying position. Various anti-g suits are described, and the author mentions a theory that Germany lost the war because its fighter pilots did not wear them. The final chapter shows that many lives could be saved in flying crashes by the use of devices to prolong the deceleration. A. E. S.

L'Astronautique

(By Alexandre Ananoff. Collection "Savoir," Libraire Arthème Fayard, 18-20 Rue du Saint-Gothard, Paris XIV. 1950. 498 pp., with 153 diagrams and photographs, and 53 tables. 800 Fr.)

M. Ananoff is, of course, the energetic leader of the *Groupement Astronautique Français* and the first recipient of the Hermann Oberth Medal. He has been responsible for many papers on space travel in the past and was organiser of the international meeting on astronautics held in Paris in September, 1950. His volume is therefore of especial interest.

It is without doubt a welcome addition to the literature of astronautics. The majority of the post-war books in our field have been in English and have done much to arouse interest in space-flight, but there are many countries where French, rather than English or German, is the "second language" and M. Ananoff's book should do much to awaken interest in these lands; certainly it should lead to a rapid growth in the number of astronauts in France itself.

The book provides a fairly well balanced account of the various aspects of the subject and is well up-to-date. Details of recent developments in the United States and elsewhere are included, as well as references to the Man-carrying Rocket, the Smith-Ross Space Station, the Expendable-Tank Step-Rocket, and other subjects which have been featured from time to time in this *Journal*, up to, apparently, the July, 1949, issue. On the whole the book is well documented and amply illustrated, several of the photographs being of great historical interest. There is an adequate index.

L'Astronautique is divided into eight sections: (1) literary origins and impracticable methods of propulsion; (2) fundamentals (gravity, escape velocity, the atmosphere, the reaction principle); (3) the propulsion system (comparison with gas turbine, ramjet, etc.; solid and liquid propellants; atomic rockets); (4) present-day rockets and future projects, including space stations and step rockets; (5) design of spaceships and spacesuits; (6) orbits and voyages, the meteor danger, relativity and rockets; (7) physiological problems, landing; (8) the development of astronautics in France and elsewhere, reasons for travelling to the planets.

This is essentially a "popular" book, and is free from mathematics, but the author has not produced a mere string of generalities; the many tables and graphs contain a mass of numerical data of considerable value. It is only natural that the section dealing with present-day rockets should be mainly concerned with A.4, in view of its achievements, though the later "A" projects are also described. The chapters on physiological effects give some interesting information and M. Ananoff is evidently a devotee of at least one of his country's (reputed) two great pastimes, for he has included a three-page passage under

the entrancing heading "La cuisine cosmique." Unfortunately, he has not thought fit to include any of those delightful recipes. But what visions (and odours?) he conjures up—*Hors d'oeuvre des Asteroïdes*; *Congre de Mare Imbrium sauté aux câpres*; *Croûte aux champignons Martiens* . . .

In view of the importance of the rocket motor, it is a pity that it has not been discussed at greater length. There are also certain errors and omissions, but that is to be expected in a first edition, and they will no doubt be corrected in due course.

It is, however, much to be regretted that the standard of production falls far short of the quality of the text. The type is satisfactory, the paper is reasonably suitable, and the cover (of paper, as is usual with continental books) bears an attractive design. But the binding literally disintegrated in the reviewer's careful hands. If rebinding is also taken into account, the total cost of this book may well be double its published price. That apart, *L'Astronautique* is well worth a place on the Interplanetary bookshelf.

G. V. E. T.

The Planet Mars

(By Gerard de Vaucouleurs. Translated by Patrick A. Moore, F.R.A.S. Faber & Faber, Ltd., Russell Square, London, W.C. 87 pp., index, illus. 10s. 6d. net.)

Turning over the impressions left by this small book it is very hard not to repeat some of the phrases used on the cover and in the Translator's Foreword. On the cover, the synopsis talks about the "brilliant brevity" of the author in his presentation of the Martian scene, whilst the able Translator, Patrick A. Moore, quotes Mr. P. M. Ryves, Director of the Mars Section of the B.A.A., when he said "No student of Mars can afford to be without this up-to-date little book."

It is extremely enjoyable to read—so many books on astronomy are not, and their reading becomes a penance in the cause of knowledge. It is admittedly a difficult subject to write about in an absorbing fashion, but success has crowned the efforts of both author and translator.

The first chapter is devoted to the motions of the Planet, the opportunities and difficulties encountered in research on the Planet, the Seasons, and the development of observation—and its record—over the long years of incessant battle in the Martian Arena. Next are described the Polar Caps together with the many theories which attempt to explain their structure and dynamics. Similarly the "Bright Regions" are examined, and in this connection Polarimetric methods of investigation are very lucidly explained.

The importance of Spectrographic analysis is emphasised in the next chapter which is devoted to the theories and research on the atmosphere of Mars. Its peculiar structure is described—the "Violet Layer" which exists and must be made up of finely divided particles of some indefinite substance. The two types of clouds common to the Planet are analysed—their relation to the "Violet Layer," their composition and velocity.

Another interesting "tool" of the astronomer is described in the following chapter dealing with the climate of Mars. The Thermocouple, when used in

its most sensitive form, together with the most excellent apparatus available, produces very interesting data on the order of the temperatures on the surface of the Planet. Radiometric measurements, although a little doubtful in their positive values, do give some idea of these conditions. At least they betray the extremes of temperature to be met with, and suggest that the noon values in summer are relatively high and are apt to give a false optimism to our ideas of existence on Mars.

The "Dark Regions" of Mars, which have figured so much in recent reports from both Russia and America, come under consideration. The variations, seasonal and local, have given rise to a healthy crop of theories, and a wealth of data illustrates these. The discussion on the probable causes of these changes and their propagation is very interseting.

A book on Mars would fail in its object if mention were not made of the "Canals." The writer cannot but admire the diplomacy and caution used by the author in this chapter! It is a delicate subject and one which is debated, if not with such zealous fire as in the beginning of this century, with undoubtable enthusiasm, and very definite ideas back the theories of both sides.

The author is perhaps a little too cautious in his brief chapter headed "Life on Mars?" which could have been developed into an absorbing discussion —even on the sparse crumbs of knowledge we possess to-day.

We can but echo the author's hope that the next cycle ending in 1956, during which Mars will be best positioned for observation, will bring a proportionately greater mass of knowledge about our intriguing "Red Planet"— aided by the new and improved equipment which should be available in the next few years. M. W. W.

The Flying Saucers are Real

(By Donald Keyhoe. Pub. Fawcett Publications, Inc., New York. 25 cents. 175 pp.)

This little book is by the journalist responsible for the article in *True* magazine which recently revived and intensified public curiosity about flying saucers. According to Willy Ley, the American Air Force requested the withdrawal of the book, on the grounds that they were, in the expressive phase of their British opposite numbers, "browned-off" with the whole subject.

This we can well believe, especially after reading Mr. Keyhoe's book, because he certainly seems to have bothered the life out of all U.S. Air Force Information Officers within range, in his exhaustive search for information. As a result of this search, Mr. Keyhoe believes that the majority of "authentic" saucer-sightings were spaceships from another planet, engaged in Terrestrial reconnaissance and surveillance. He also believes that the Air Force knows this, and is engaged on a carefully-planned scheme to break the tremendous news to the world gradually, through a series of alternating denials and stimulating reports, rumours and official releases of mysterious information. He thinks this official policy ill-advised, and unnecessary (the authorities say it is non-existant !) because:—

> "The American people have proved their ability to take incredible things. We have survived the stunning impact of the Atomic Age. We

should be able to take the Interplanetary Age, when it comes, without hysteria."

This passage, which concludes the book, surely deserves immortality. We are pro-American ourselves, mind you, and happen to believe it is true—but perhaps not in the saucerian sense that the author intended.

Mr. Keyhoe's book is written in much less sensational style than we should have expected, though with a certain naive touch which keeps breaking through, and some technical inaccuracy and over-simplification in places. It is well worth reading, whether you agree with the author's conclusions or not (this reviewer does not, much as he would like to), simply because it collects together for the first time the whole amazing saucer-story. Admit that this has all arisen from a combination of hoaxes, faulty recognition of familiar objects, and mass hysteria—and you still have a social phenomenon almost as fascinating as a real flying saucer! A. V. C.

CORRESPONDENCE

SIR,

Lunar spacesuit

Mr. Cross's letter (p. 258, September *Journal*) raises some interesting matters which serve to differentiate certain theoretical and practical aspects. He challenges the writer's statement that precise calculation of the radiative exchanges is difficult and correctly states the formula which may be applied for evaluation of the rate of heat transmitted *per unit area* under any given condition. The difficulty is not on this point but that exterior conditions on the Moon vary enormously, especially by day, when part of the suit may be illuminated by direct sunlight, part of it in complete darkness, and in part exposed to heat from the surrounding terrain, which is itself at some intermediate, and non-uniform, temperature. The *total* calorific intake or disbursement may—and will—therefore vary wildly from time to time according to the position of the Sun, the type of country being traversed, and the ever-changing orientation of our explorer in relation to environmental factors. These difficulties are further multiplied by uncertainty about the emissive, absorptive, and transmissive properties of the (as yet non-existent) suit. However, if one makes tentative assumptions in respect of materials, structure, and exterior conditions, then an evaluation is possible; and this approach was in fact adopted in assessing the heat exchanges of the suit in question.

Mr. Cross rightly points out that a cellular structure does not provide ideal thermal insulation, and advocates use of multi-layer aluminium foil. It is not clear, however, how Mr. Cross proposes to build up this sort of structure, and one cannot help feeling that it would, in practice, have to be of a cellular nature. "Thermos-flask" construction for the rigid helmet was envisaged by the writer, but he doubts whether such simple construction could be applied to the dress itself. Some further discussion and demonstration of practicability by Mr. Cross would be welcome—particularly as regards avoidance of crushing, which would largely destroy the desired "thermos-flask" conditions. One may also wonder whether an aluminium foil suit, even one backed with a

rubberized lining, would be sufficiently flexible, robust and resistant to penetration by sharp fragments. After all, one must assume that our explorer is doing a job of work. Nor should we forget that there might be risk of being deafened by crackle.

The cape was incorporated to show a simple possibility in connection with the regulation of temperature, *especially under night conditions*. Certainly control is not automatic—nevertheless, on Earth, we get along nicely without mechanized overcoats. Use of the cape avoids need to transport to the Moon, and then carry, a fairly massive and bulky cooling unit. This simplicity and reliability may be an overriding consideration in the initial stages of lunar exploration, when—because of technical difficulties—it may be necessary to avoid high day temperatures. . . Incidentally, if trouble is experienced with condensation in the blackened chest area, surely this could be avoided by the more complete removal of excess water-vapour?

Although the writer noted the possibility of using water under reduced pressure as a spacesuit coolant, he is not quite so optimistic as Mr. Cross seems to be. Some more detailed theoretical study is needed here, and a little confirmatory practical experiment, possibly with mixed refrigerants, could be carried out. One should remember that the temperature difference between the water and the circulating air will not be very great, and it may be difficult to carry off enough heat. However, ice, even super-chilled ice, could be used. In some experiments with water under reduced pressure, the writer was rather shaken by the fact that a violent "gulp" due to escape of occluded gases resulted in the magical appearance of a block of ice. No doubt this uncertain behaviour (which can occur with other refrigerants, and may also result in the case of rapid vaporization), could be overcome; indeed, perhaps the only precaution necessary is prior degassing of the coolant, if it be water. However, the moral emerges that important secondary effects may be overlooked. Theory must, in fact, be complete in scope and detail before it is possible to predict the result of a reaction. Even so, practical confirmation is needed.

It is true that the body's off-throw of water from the lungs and skin could furnish a substantial part of the refrigerant. However utilization of this water (principally that from the lungs) for cooling purposes introduces elaboration of the apparatus, for which reason this possibility was ignored in the published design. The illustration, though fairly detailed, does not show the air-circulation system complete. As Mr. Cross says, the atmosphere would have to be circulated through the limbs, not just the trunk. The *Journal* shows that cooling is regulated by by-passing the refrigeration tank and by valve-control of the pressure on the coolant. This gives mastery of humidity irrespective of absorption by the chemicals of the carbon dioxide extraction unit.

Mr. Cross chides me for omitting to deal with the disposal of waste body-products. Urine could be coped with by means of a small container which could be disposed of via the chest air-lock, or there might be a sealed tube down one leg of the suit. Faeces might, if necessary, be disposed of in a somewhat similar fashion.

Use of hydrogen peroxide as a source of oxygen was mentioned but not advocated for the reason given by Mr. Cross, and because the water content

adds unwanted weight. . . Incidentally, the dissociation calories might, however, be utilized under night conditions.

Perhaps this joint discussion has served to clear up queries which may have arisen in the minds of other readers of our *Journal*. In any case I wish to thank Mr. Cross for his interest and constructive criticism. It is certainly possible to envisage other ways of dealing with the problems of spacesuit design; indeed the present illustration can only be regarded as demonstrating the physical and physiological requirements and offering some tentative, and not necessarily the best, solutions.

HIGH WYCOMBE. H. E. ROSS.

Planetary Bacteria

SIR,

I was very pleased to read Mr. Harper's comments on my article which appeared in the March issue of the *Journal*.

Before I answer Mr. Harper's criticisms (p. 254, September *Journal*) I should like to make it clear that I do not consider that there is any great possibility of infection of space travellers by pathogenic organisms on another planet, but, as I think Mr. Harper will agree, the possibility, however remote, does exist, and we ought to consider it.

I think probably the principal reason for Mr. Harper's letter is his too literal interpretation of the label "bacteria" which I applied to my hypothetical organisms. I used the term "bacteria" because I feel that extra-terrestrial potentially pathogenic organisms (this is, I think, the best description), if they exist, will have certain features in common with our terrestrial counterparts. I have in mind, for example, the soil bacteria.

As Mr. Harper rightly points out, many of our "home-grown" pathogenic bacteria have evolved along specialised lines dictated by the parasitic habit. I disagree, however, when he says that a long period of evolution must have been necessary for them to have attained their parasitic mode of existence. The bacteria share, with other primitive organisms, the power of rapid proliferation which enables mutant (new) strains to appear with a frequency unknown in higher organisms. The mutant form (if better adapted to deal with its environment) will, under the influence of natural selection, be able eventually to oust the original (and parent) strain from its ecological niche. Thus a new strain may evolve literally overnight.

Bearing in mind, therefore, the behaviour of our terrestrial bacteria, if we imagine organisms sharing with their powers of rapid reproduction, great plasticity in their ability to live under the most stringent and variable conditions of food supply, light and temperature, then we have an organism which could become pathogenic.

I did not suggest, as Mr. Harper thinks, that growth of organisms on a culture medium is a direct index of pathogenicity. I said that "they *might* find growth possible in humans." In any event growth of organisms on or in a culture medium, or inoculated animal, would indicate that their physiological processes must be comparable to those of terrestrial bacteria.

LONDON, N.14, EDWIN R. NYE,

Antigravity

SIR,

I was interested in Mr. A. C. Clarke's comments on the antigravity devices of science-fiction, given in his paper "Space-Travel in Fact and Fiction" in your September issue. I feel, however, that in dealing with this idea so briefly, the most important (indeed the only important) aspect of interest to real science, was overlooked.

Mr. Clarke effectively dealt with fiction's antigravity screen by showing how, if it were possible, it could be used to contravene the law of energy conservation and thus produce perpetual energy. When he went on to say that there is no fundamental objection to a *driven* antigravity device, however, he might well have added that here, too, if energy equations are to be satisfied, the overall power required to operate the device cannot be less than that required for direct propulsion by more conventional methods.

Even assuming that by supplying very much less power some sort of chain-reaction in the antigravity material could be initiated, thereby producing "virtual energy" as more and more of the stuff ceased to be attracted by conventional mass and was instead repelled from the earth (or other planet), the power thus saved at take-off would, as Mr. Clarke points out, have to be expended instead in order to land at the end of the voyage through space.

I suggest that the only really practical use for any antigravity device (assuming for a moment that such is possible), would be as an *energy store*, whereby the large amount of energy required for take-off could be supplied in advance from bulky machinery on the ground, giving the working material "negative gravity" with, say, a half-life of a few hours (to allow a reasonable payload to the moon).

In this purely speculative matter of a possible antigravity material, it seems to me that if it ever should be achieved, it will result from some modification of the binding forces between elementary nuclear particles. Whether this modification, once begun, will spread through the material as a chain-reaction (with or without a controllable "conversion rate"), or whether the material will merely revert, at a fixed or perhaps controllable rate, to its "positive" or normal gravity condition, is even more speculative but should not, I think, be entirely dismissed on that score.

RADLETT, HERTS. BRUCE M. ADKINS.

FIRST NUMBER NOW READY

GEOCHIMICA ET COSMOCHIMICA ACTA

The aim of this Journal is to publish original research papers by scientists of all countries on geochemistry and cosmochemistry, such as have hitherto been scattered over a wide range of geological, mineralogical, chemical and astronomical periodicals. All contributions to the new Journal, which is completely international in concept, will be published in English, French and German.

Subscription rate in U.K. £3 10s. per volume post free

BUTTERWORTH-SPRINGER LTD. • BELL YARD, TEMPLE BAR, LONDON, W.C.2

JOURNAL BINDERS Bind your B.I.S. Journals as they are received by using a "Cordex" self-binder.

The binder holds the complete publications for one year, i.e. six copies of the Journal, the Annual Report and List of Members, and Index.

The cases are strongly bound in blue cloth, titled with volume number on spine, and are available at 5s. 6d. each (post free) on application to the Secretary, B.I.S., 157, Friary Road, London, S.E.15.

BOOKS on PURE AND APPLIED SCIENCE ALWAYS AVAILABLE

Catalogues sent post free on application. Please state interests.

H. K. LEWIS & Co. LTD. 136 GOWER STREET, LONDON, W.C.1.

Established 1844. *Telephone: EUSton 4282 (5 lines).*

MÉMORIAL DE L'ARTILLERIE FRANÇAISE

Science and Technology of Armament

A journal published since 1922 by the French Ministries of National Defence (Army—Navy—Air Force), of Education, and of Industrial Production, with the co-operation of scientific and industrial organisations.

Successor to: **Mémorial de l'Artillerie de la Marine (1873–1906),** and: **Mémorial de l'Artillerie Navale (1907–1915).**

This review publishes original papers dealing with artillery and all related sciences, translations, and relevant bibliographies. It is addressed, in consequence, to all who are concerned with the study, construction and use of war material, in particular on subjects initiated or extended by the last world war.

Four issues per annum (size 26 × 17 cm.) of about 250 pages each.

Editorial address: 10, rue Sextius Michel—PARIS (XV^e^).
Subs. and selling: Imprimerie Nationale, 27, rue de la Convention, PARIS (XV^e^).
Subscription price per year: **France 3,000 francs, Abroad 4,000 francs.**

PRINTED BY W. HEFFER & SONS LTD., CAMBRIDGE, ENGLAND

THE DE HAVILLAND "SPRITE" ROCKET

The above picture shows the A.T.O. rocket in the test bed, together with four Fellows of the Society who were instrumental in its development.

Left to right, W. N. Neat, A. V. Cleaver, R. A. Grimston, and E. B. Dove.

Annual Report

of the

British Interplanetary Society

(Limited by Guarantee)

FIFTH ANNUAL GENERAL MEETING

NOTICE IS HEREBY GIVEN that the FIFTH ANNUAL GENERAL MEETING of the BRITISH INTERPLANETARY SOCIETY will be held in the Kent Room, Caxton Hall, Caxton Street, London, S.W.1, on **Friday, the 8th day of December, 1950,** at **6** o'clock in the evening precisely, for the transaction of the business specified in the Agenda below.

AGENDA

1. To hear the Chairman's speech.
2. To receive the annual statement of accounts and balance sheet and the auditor's report thereon.
3. To resolve "That the Authorised number of the Society's membership be increased to an indefinite number of Members."
4. To elect four Members of the Council of the Society. In accordance with the provisions of Article 15, the following existing Members of the Council will retire at that meeting and being eligible, offer themselves for re-election:—

   E. Burgess. Dr. A. E. Slater.
   A. C. Clarke. R. A. Smith.

   The following additional names have also been nominated:—

   A. M. Kunesch *Member.*
   P. A. Moore *Member.*
   M. W. Wholey *Fellow.*

   Since the number of nominations exceeds the number of vacancies, election will be by postal ballot. The necessary ballot papers are enclosed with this agenda.
5. General discussion on the affairs of the Society during the past year. Members are invited to submit any questions or suggestions they have in mind, to which the Chairman and Secretary will reply as necessary.
6. Any other business.

By order of the Council,

L. J. CARTER,
Secretary.

Members who cannot be personally present at the Meeting may appoint by proxy some other person (who must be a Member of the Society), to attend and vote on their behalf, subject however to the limitation that a proxy cannot vote except on a poll.

SYLLABUS OF ADDRESSES DELIVERED TO THE LONDON MEETINGS OF THE SOCIETY DURING THE SESSION 1949–50

Saturday, 1st October, 1949

The session opened with a "Conversazione" which enabled members to see a large number of photographs of recent rocket experiments, and to afford them an opportunity to meet Members of the Council and each other. A number of paintings, diagrams, drawings, and several models were also exhibited and members and their friends were enabled to discuss technical and other points with the officials who were in attendance.

Later in the evening a number of lantern slides illustrating the history of rocket development were displayed, and two films shown, *viz.*:—

(*a*) *Solar Prominences* (taken by Professor Menzel at Harvard High Altitude Observatory), and

(*b*) *The Rotation of Jupiter* (made at the Lick Observatory).

A report of the meeting, description and list of exhibits, and reviews of the films appeared in the *Journal* of the Society, Vol. 8, No. 6, November, 1949.

102 members and visitors were present.

Saturday, 19th November, 1949

"A Symposium on Medical Problems associated with Space Travel." The meeting was divided into three short papers:—

(*a*) *Psychological Problems of Space-Flight*, by E. T. O. Slater, M.A., M.D., F.R.C.P. (Lond.)

(*b*) *Lunar Space-Suit*, by H. E. Ross.

(*c*) *The Balancing Mechanism of the Inner Ear*, by A. E. Slater, M.A., M.R.C.S., L.R.C.P.

122 members and visitors were present.

Saturday, 3rd December, 1949

By courtesy of the Ministry of Education, a special film show was held at the Science Museum Lecture Theatre, when the following films were shown:—

(*a*) *Operation Backfire*, on the subject of the British Cuxhaven V2 trials.

(*b*) *Faster than Sound*, a brief account of the Vickers Transonic Missile.

(*c*) *Atomic Physics* (*Part V*), dealing with power generation from nuclear reactors.

(*d*) *Solar Prominences*

(*e*) *An Eclipse Expedition.* Both were pre-war films of French origin.

A review of the programme appeared in the Society's *Journal*, Vol. 9, No. 3, May, 1950.

187 members and visitors were present.

Saturday, 7th January, 1950

"Initial Objectives in Astronautics," by K. W. Gatland, A. E. Dixon and A. M. Kunesch. This lecture surveyed the major problems involved in

the design of a man-carrying rocket intended to fulfil an early interplanetary objective. Consideration was given to the expendable-hull construction, and dealt with the load-carrying capacities of certain types of structure, application of a nuclear reactor, shielding problems, and application of the orbital stage technique to secure the maximum reduction in initial projection mass.

This paper was printed in the Society's *Journal*, Vol. 9, No. 4, July, 1950.

90 members and visitors were present.

Saturday, 4th February, 1950

A discussion evening on the theme "The Effects of Interplanetary Flight," in which a number of members of the Society took part. The discussions ranged from a purely technical field to other aspects of wider significance.

A report of the discussion appeared in the *Journal*, Vol. 9, No. 3, May, 1950.

70 members and visitors were present.

Saturday, 4th March, 1950

"The Testing of Rocket Motors," by Dipl. Ing. H. F. Zumpe, which described present methods of testing and measurements taken, together with the results and applications of such measurements. This was followed by a discussion of possible future test methods and measurements, including a consideration of methods of gas temperature, velocity and pressure measurements, and gas composition and mixture ratio determination.

The paper was reproduced in the Society's *Journal*, Vol. 9, No. 3, May, 1950.

57 members and visitors were present.

Saturday, 1st April, 1950

"Space Travel in Fact and Fiction," by A. C. Clarke, B.Sc., which briefly surveyed the more important works in this field of literature, extending now over some eighteen centuries, with special reference to the means of transport proposed. The lecture was illustrated with a large number of slides, and was reproduced in the *Journal* of the Society, Vol. 9, No. 5, September, 1950.

102 members and visitors were present.

Saturday, 6th May, 1950

A repeat performance of the film show on 3rd December, 1949, was given on this date at the Science Museum Lecture Theatre (by courtesy of the Ministry of Education), for the benefit of members unable to attend the previous showing.

The astronomical film on solar eclipses was not shown on this occasion, but a further film showing scenes of the Earth taken by a camera in the tail of a high-altitude rocket was exhibited in lieu, together with a short sequence from "Spaceship I departs."

141 members and visitors were present.

SYLLABUS OF ACTIVITIES OF THE NORTH-WESTERN BRANCH DURING THE SESSION, 1949–50

Saturday, 22nd October, 1949

"Possibilities of Interplanetry Travel," by L. Sykes and E. Burgess, F.R.A.S. An introduction to the dynamical requirements of spaceflight. The rocket as a vehicle of escape.

14 members and visitors were present.

Saturday, 26th November, 1949

"Other Planets, their physical conditions and possibilities of Life," by J. C. Farrer, F.R.A.S. A lecture which indicated what man would be likely to find when he leaves the Earth to explore other worlds, the difficulties of living conditions and how some of these might be overcome.

35 members and visitors were present.

Saturday, 10th December, 1949

Discussion Evening in which the matters presented in the two previous lectures were discussed. This proved a most successful evening for the small group who participated.

12 members and visitors were present.

Saturday, 14th January, 1950

"Spacestations," by E. Burgess dealt with the establishment and uses of artificial satellites for television relay services, cosmic ray recording, telemetering, solar spectroscopy from high altitudes, etc., and future possibilities of manned stations.

29 members and visitors were present.

Wednesday, 8th February, 1950

Visit to Godlee Observatory, Manchester. Many clear breaks in the clouds enabled members to use the 8 in. refractor and 12 in. reflector. The operation of the instruments was explained before observing the planet Saturn, double star Castor, clusters in Gemini and Perseus, the Orion Nebula and the Great Nebula in Andromeda.

16 members and visitors were present.

Saturday, 11th March, 1950

Several short papers were read on this evening:—

(*a*) *Transfer Orbits of Minimal Impulse*, by C. A. Cross, showing that the tangential ellipse is not the most economical orbit and describing several spiral orbits and the technique for establishing spacestations with the minimum expenditure of energy. Developments of sub-orbital technique.

(*b*) *Effects of Acceleration on the Human Body*, by R. Armstrong, B.Sc., described the effects of transverse, positive and negative accelerations on the body, the brain, the circulatory system and the larger organs. Possibilities of overcoming these effects.

(*c*) *Lunar Surface Features*, by E. Burgess, a series of sixty slides of various regions of the Moon.

27 members and visitors were present.

Saturday, 15th April, 1950

The following films were shown in a programme lasting for nearly three hours:—

(*a*) *Principles of Jet Propulsion.*

(*b*) *The V.1 Flying Bomb.*

(*c*) *Principles of Rocket Propulsion.*

(*d*) *Testing of a Guided Missile.*

(*e*) *Television Control of a Guided Missile.*

(*f*) *Faster than Sound.*

(*g*) *The Fairey "Stooge"* (shown by courtesy of the Fairey Aviation Co. Ltd.)

(*h*) *The German A–4 Rocket.*

A small exhibition was open both before and after the film show, a note of which appeared in the Society's *Journal*, Vol. 9, No. 5, September, 1950.

241 members and visitors were present.

Saturday, 20th May, 1950

"The Sun," by J. C. Farrer, F.R.A.S., a talk on modern theories concerning the sun, generation of solar energy and the origin of the planetary system.

Two short films were also shown:—

(*a*) *Spaceship I Departs.*

(*b*) *Principles of Rocket Propulsion*, made by members of the North-Western Branch.

20 members and visitors were present.

Friday, 21st July, 1950

Visit to the Godlee Observatory, Manchester. After a cloudy day the skies cleared and members were able to see a projected image of the Sun on which several conspicuous spot groups were visible. The Moon was observed in daylight, but owing to difficulties caused by repairs to the R.A. axis it was not possible to observe Mars.

11 members and visitors were present.

FIFTH ANNUAL GENERAL MEETING

(*For the convenience of members unable to attend, the Chairman's Address is reproduced below.*)

CHAIRMAN'S ADDRESS

GENTLEMEN,

In presenting for your approval this detailed report of the Council for the period 1st October, 1949 to 30th September, 1950 (inclusive), it gives me a very real and genuine pleasure to be able to say that this has been another very successful year for the Society. In fact, this fifth year of our post-war existence may fairly be described as the most successful of all to date, and, as in previous years, I wish to draw the attention of all members to the fact that we have the tireless and quite voluntary labours of our Secretary, Mr. L. J. Carter, to thank for much of our good fortune.

Membership.

At the end of the 1949–50 session, the membership totalled 925, comprising 6 Honorary Fellows, 239 Fellows and 680 Members. This represents an increase of no less than 347 over the total membership last year.

Of even greater significance for the progress of the Society is the gratifying fact that—if we neglect the abnormal 1945–47 period, when the Society was reforming—the rate of increase of the membership is itself increasing. The following figures illustrate this:—

Total membership at 30th September,	1946 = 269		
" " " " "	1947 = 444	Annual increase	= 65%
" " " " "	1948 = 502	" "	= 13%
" " " " "	1949 = 577	" "	= 15%
" " " " "	1950 = 925	" "	= 60%

You will be aware that we are required by law to register the upper limit of membership which we intend to admit to the Society. I now wish to request your formal agreement that we should apply for the B.I.S. to be placed in the category of being unrestricted in its number of members, for which we shall merely have to pay the small fee of £12 10s. 0d. You should not, of course, take this resolution too literally! It may well be that future years may not bring quite such a striking increase in our numbers, but the Council feels confident that the B.I.S. may now be regarded as fully established and likely to grow steadily in both membership and influence.

Publications.

During the past year, the Society has issued the following publications:—

(*a*) Six *Journals*: Vol. 8, No. 6 (November, 1949) and Vol. 9, Nos. 1–5 (January, March, May, July and September, 1950.)

(*b*) The Annual Report and List of Members for 1949, in the November of that year.

(*c*) Revised third and fourth printings of the Book List, which continues to be popular; it is intended to bring it up to date at frequent intervals, and members may always obtain copies of the current List on application.

Last year, I stated that we should also publish the Memorandum and Articles of Association and the Bye-Laws of the Society as a separate pamphlet, but the Council, for reasons of convenience and economy, finally decided to incorporate them in this present Annual Report; they appear elsewhere in the section entitled "Constitution."

In addition, Fellows of the Society have received the following:—

American Rocket Society Journals, Nos. 78, 79, 80 and 81.

Pacific Rocket Society Journals, Vol. 3, No. 4 and Vol. 4, Nos. 1 and 2 (combined issue.)

Our improved financial position has enabled us to increase the size of individual issues of the *Journal* quite substantially, as compared with last year; we hope to be able to issue a 60 page *Journal* on each occasion if, during the next few years, our membership continues to grow as it has done during 1950. We have also increased the number of copies of the *Journal* printed per issue from 1,500 to some 2,000. Even this does not make it possible to keep extra copies in stock for very long, due to the large number of enquiries for membership, etc., which have to be dealt with, and it often happens that issues go out of print within a few months of printing.

We have improved considerably the coverage of our Abstracting Service, but should still welcome any help from members in this connection.

The Publications Committee, which considers all material submitted for printing by the Society (as described in the Constitution), has continued to consist of Dr. Shepherd, Messrs. Clarke, Carter and myself.

Lectures and other General Meetings.

As recorded elsewhere in this printed Annual Report, the Society held eight General Meetings in London during the period under review, and a further nine in Manchester, under the auspices of our North-Western Branch These figures again represent an improvement on the previous year, and the increase in provincial activity is particularly gratifying to the London Headquarters. Discussions have been held in Council on the possibility of organising some future meetings in a Midland area, and any suggestions from members on these lines would be welcomed.

There has been a further small increase in the average attendance at our meetings. Film shows continue to prove very popular, but it is difficult to arrange these at very frequent intervals because of the shortage of suitable material which is not classified under security regulations.

We continue to receive numerous requests to supply lecturers to outside bodies, and in fact the amount of work of this nature undertaken during the past year was comparable with that during 1948–49. It again fell to the lot of some half-dozen Council Members to discharge this important responsibility of the Society, which is a most valuable means of informing public opinion about astronautics. We have now prepared a full set of lecture notes and a slide library, which are available to any members who are both willing and qualified to assist in this work.

Library.

As reported in previous years, it has always been our ambition to make available to members a book lending and reference service. In May of this year, we were able to make a start on this by announcing that some 40 representative books were now available on loan to Fellows. This latter restriction was enforced because it was desired that the clerical work involved should be allowed to build up only gradually, and in any case the Council feels that our Fellows are entitled to first consideration in any additional service provided, in view of the larger subscriptions which they pay.

However, during the coming year it is hoped to extend this scheme to all members, and also to increase the number of available books covered by it. Already there is available, to both Members and Fellows, a lending service which covers some 500 papers and magazine articles on astronautics, including almost complete files of *Journals*, etc., published by our own and foreign societies in this field.

All these library activities are organised by Mr. J. Humphries, in addition to his regular duties of preparing the *Journal* Abstracts, and he together with Messrs. Clarke, Carter, Thompson and myself, forms the present Library Committee, as laid down in the Constitution: this has held one formal meeting during the past year.

List of books, articles, etc. available may be obtained on application direct to Mr. Humphries.

Technical Advisory Committee.

This consists of Dr. L. R. Shepherd (Technical Director), Mr. G. V. E. Thompson (Deputy Technical Director), and myself, together with such other members as may be co-opted for any special work or meetings. The Committee has met three times under Dr. Shepherd's chairmanship during the past year. Its work has resulted in a number of papers for our *Journal*, which have either appeared already or will do so in forthcoming issues.

Books, Radio, Television and Films.

The year under review has been notable for a number of events under these headings, which are worthy of notice in passing, partly because the Society has been associated with many of them, and partly because they have probably exerted an influence on the growth in our membership during this period.

The book *Interplanetary Flight* by our own Arthur C. Clarke appeared under the imprint of Temple Press, and we were glad to see the decision taken (by Sidgwick and Jackson) to bring out an English edition of the Ley-Bonestell *Conquest of Space*, more particularly since we had expressed the strong hope that this would be done in our *Journal* review.

Early this year, the B.B.C. Northern Regional Children's Hour paid some attention to interplanetary travel, and a talk on the subject by Dr. E. T. O. Slater, A. C. Clarke and myself was transmitted twice in the Overseas Service. The Fred Hoyle series of talks on Cosmology, with their frequent reference to

life elsewhere in the Universe, have of course been repeated, and Dr. Porter, in one of his regular astronomical talks, spoke confidently of the fairly imminent achievement of space-flight. Two television talks specifically on the subject of astronautics were also given, again by Arthur Clarke.

The films *Rocketship – XM* and *Destination Moon* were shown in London, and subsequently released, quite recently. The second of these was a most praiseworthy effort, made with careful regard to technical accuracy in almost every respect, and the Society was glad to supply what assistance it could in connection with the publicity arrangements for it. These included the display of an excellent model of the Smith–Ross man-carrying rocket, made by Mr. W. G. Barrett (a Member), in the foyer of the theatre where *Destination Moon* received its English premiere.

Astronautical Congress in Paris.

During the past year, we have been in close touch with the French and German societies on the organisation of this. Thus, although the Congress itself opened on the date of September 30th (which strictly concludes this year), and extended to October 2nd, it seemed logical to include it in this survey. An account of the proceedings in Paris is therefore given elsewhere in this year's printed Annual Report.

Accounts.

The Finance and General Purposes Committee mentioned in the Constitution was established by Council to consist of the Chairman and Secretary (*i.e.*, myself and Mr. Carter). This small Committee, of course, deals merely with the day-to-day affairs of the Society, meeting or corresponding as necessary for this purpose; all major matters are referred to Council for their joint consideration.

The general financial position of the Society remains satisfactory. In fact, our notable increase in membership during the year, while it has encouraged (and, indeed, necessitated) an increase also in our activities and expenditure, has made possible a slight improvement in this position.

You will remember that last year we inaugurated the practice of setting aside a "Subscription Reserve," to cover the period between the end of the financial year (September 30th) and the subscription year (December 31st). Last year this "Subscription Reserve" stood at £80; this year it has been increased to £100.

Another example of the way in which we are currently providing some prudent reserves for future expenditure is afforded by the Capital Fund set up to permit the future purchase of any necessary equipment—for example, office furniture at such time as the Society is in a position to acquire its own premises. In previous years, we have merely transferred all Compounded Life Subscriptions into this Fund; last year, it was referred to as the "Compounded Subscription Reserve," and stood at £86. This year, we have transferred an additional £30 into it from current income, and re-named it the "Establishment Fund Account"; it now totals £134. In view of the purpose for which it is intended, I feel

justified in inviting members to send us any donations they can afford to speed the increase of this Fund. The Council intends, in future years, to make as large transfers as can be spared from current expenditure into the Fund; the days when the Society can rely entirely on voluntary labour and free accommodation at private addresses, cannot last indefinitely.

A list of the donors of amounts over 5s. received during the year appears on page 364 of the printed Annual Report.

The considerable increase in our expenditure on publications is, of course, largely due to the increases in number of printed pages and copies of *Journals*, etc., actually ordered. However, there has again been an increase in printing charges with which to contend, a factor which reflects the general continued increase in cost of living and which makes it difficult for Council to expand our publications as much as it would wish, without increasing subscription rates.

Apart from the above points, there is little in the Accounts to which it is worthwhile calling your attention, except perhaps to illustrate the obvious fact that the Society's continued growth is strikingly reflected by our annual income and expenditure accounts, the totals of which are as follows:—

1945–46 = £396 0 7	1948–49 = £1,074 5 9
1946–47 = £733 19 11	1949–50 = £1,506 1 8
1947–48 = £851 17 3	

Council.

During the past year, your Council has held nine meetings for the conduct of the Society's business. We have been glad to welcome back among us Mr. P. E. Cleator, the Founder of the B.I.S., when he decided to return to this country from South Africa.

A member recently wrote to the Secretary asking what duties were performed by individual Council Members. I am satisfied that this enquiry was made in a genuine spirit of curiosity, which may be shared by many other members; if it were otherwise, I should be tempted to reply rather more exhaustively! As it is, I should like to assure you that even the following brief survey is not intended as any exaggerated claim for credit to be paid to the people concerned.

However, it must be remembered that, in our Society at present, every one of the hundreds of tasks which arise must be done by some voluntary officer in his leisure time. I have often referred to our Secretary's efforts, but it is also true that all Council Members have never been found wanting in this connection. Without exception, for example, they have undertaken to deal with whatever part of the Society's voluminous correspondence enters their particular specialised sphere (*e.g.*, Dr. A. E. Slater on medical matters). All of them have contributed lectures or other articles to our proceedings. Merely by attending meetings of Council and its Standing Committees they have contributed to the development of our Society—for I can assure you that the government of the B.I.S. is (and I hope always will be) characterised by vigorous democratic debate, with all concerned taking an active part.

Apart from this, however, I should like to pay tribute to Messrs. Burgess, Clarke, Humphries and Thompson—who have shared with me most of the burden of the outside lectures; to Mr. Clarke for his work as Assistant Secretary,

which has relieved Mr. Carter and myself of much routine work; to Mr. Humphries for his Library and *Journal* Abstracts activities; to Dr. Shepherd and Mr. Thompson for running the technical side of the Society, and to Mr. Thompson also for some secretarial and translation work; to Messrs. Smith and Ross for their liaison with model-makers, and to Mr. Gatland for his regular "Research Scene" *Journal* feature and other publicity work. Especial mention must also be made of Mr. Burgess, who is responsible for the adminstration of our North-West Branch, and who has also done much photographic work in connection with slides, etc. Although he is unable to visit us in London as frequently as both we and he would desire, he is very active in the conduct of the Society's affairs.

In making these last few remarks, which by no means exhaustively cover the topic, I have personally been influenced by two motives. The first is to show that the Society can use any assistance in its activities which members care to volunteer; the Council would welcome any constructive approach of this nature. The second arises from the consideration that some other Chairman of Council will be giving next year's Report, since (in accordance with Bye-law 28) I shall be retiring at the end of 1950; before I vacated the Chair (which I have occupied for three years with so much pleasure), I wanted to pay this tribute to all the hard-working Ordinary Members of Council.

This year, in accordance with Article 15, four members of the current Council have retired, as follows:—Mr. E. Burgess, Mr. A. C. Clarke, Dr. A. E. Slater and Mr. R. A. Smith.

All have offered themselves for re-election if you so desire. Elsewhere in the printed Annual Report there are listed the names of the other nominations to Council received, and voting forms for a postal ballot have been sent to all members. Following the discussion and, I hope, formal approval of this Report of the work of the 1949–50 Council, we shall proceed to announce the names of those elected to serve in the coming year.

I am sure that my successor as Chairman in 1951 will be able to count on the loyal support and hard work of Council, as I have done, and that he will lead the Society through another successful year.

A. V. CLEAVER,
Chairman of the Council.

8th December, 1950.

REPORT ON FIRST INTERNATIONAL ASTRONAUTICAL CONGRESS, PARIS 1950

By A. V. CLEAVER

(*Chairman of B.I.S. Council*, 1947–1950, *and head of British delegation*)

Astronautical societies exist, have existed, or are in process of being formed, in most of the technically-active countries of the world. Attached to this report is a list of those bodies of which the B.I.S. currently has knowledge. Most of them have maintained some sort of contact with one another, either officially, or at least by the exchange of correspondence between private members and of their publications. Some closer co-ordination has, however,

always been recognised as being very desirable. We have on file, at the B.I.S., some very interesting correspondence between Prof. Oberth, Herr Willy Ley (both then of the V.f.R.), Mr. G. E. Pendray of the American Interplanetary Society (now the A.R.S.), and our own P. E. Cleator; this dates back to 1931–33, and represents an early attempt at international co-operation, unfortunately destined to be fruitless.

It is to the initiative of the post-war German society—the Stuttgart G.f.W.—and of the Groupement Astronautique Français, that we owe a renewed attempt to achieve the same objects, which, moreover, this time looks like being successful. Above all, our thanks are due to M. Alexandre Ananoff (of the G.A.F.), who undertook almost single-handed the tremendous task of organising the First International Astronautical Congress of the world, on which I am now reporting. Before I proceed any further, I should like to express the unanimous opinion of the British delegation that the Congress was a great success, and offers immense promise for increasing the value and influence of the astronautical movement throughout the world.

Attendance

Invitations to send delegates had been addressed by M. Ananoff to all known astronautical organisations; for various reasons, some were unable to accept, and the final representation was as follows:—

Argentine: *Prof. T. M. Tabanera, President of the Sociedad Argentina Interplanetaria.*

Austria: *Dr. M. F. Cap, President of the Oesterreichische Gesellschaft für Weltraumforschung.*
Dr. H. J. Rückert.
Ing. F. Schmiedl (the rocket-post pioneer).

Denmark: *Dr. L. Hansen, Vice-President of the Dansk Selskab for Rumfarts-Forskning.*

France: *M. A. Ananoff, Director of the Groupement Astronautique Français.*

Germany: *Dr. G. Loeser, Council Member of the Stuttgart Gesellschaft für Weltraumforschung.*
Herr H. H. Koelle, Council Member of the Stuttgart Gesellschaft für Weltraumforschung.
Dr. W. Brugel, also of the Stuttgart G.f.W., and the author of the book "Manner der Rakete."
Herr F. K. Jungklaass, of the Hamburg G.f.W.
Herr C. Oesterwinter, of the Hamburg G.f.W.

Gt. Britain: *Mr. A. V. Cleaver, Chairman of B.I.S.*
Dr. L. R. Shepherd, Technical Director of B.I.S.
Mr. A. C. Clarke, Assistant Secretary of B.I.S.
Mr. E. Burgess, Assistant Secretary of B.I.S. (NW-Branch).
Mr. J. Humphries, Council Member of B.I.S.

Spain: *Senor T. Mur, President of the Societe Espagnole d'Astronautique.*

Sweden: *Ing. A. Hjertstrand, who represented a group which is attempting to form a Swedish society.*

Also present throughout the Congress (though not representing any national society) was the famous pioneer (now one of our Honorary Fellows), Dr. Eugen Sänger, together with his collaborator over the last fourteen years, Frau Dr. Irene Bredt; both are now resident in France. Similarly, Ing. Nebel, famous for his work at the old V.f.R. "Raketenflugplatz," was in attendance.

General regret was expressed at the absence of American representation, though the Detroit Rocket Society and the United States Rocket Society sent messages of goodwill. We of the B.I.S. undertook to make every effort to secure the participation of the American and Pacific Rocket Societies, in some form, at the London Congress next year. M. Ananoff informed us that he had sent a formal invitation to the Russians, but had not received even an acknowledgment.

Undoubtedly, there would have been more delegates but for the high cost of travel, since all who did come (like ourselves) were paying their own expenses; this consideration of finance weighed particularly heavily against those, such as the Austrians, who had to contend with unfavourable exchange rates. Another difficulty for many was the delay in obtaining visas; this, at the last minute, prevented the attendance of Prof. Oberth, Dr. Gartmann of the Stuttgart G.f.W., Ing. J. Stemmer, and several other intending visitors. One has to hear of some of the problems currently confronting people on the continent of Europe in order to appreciate them—and when one has understood, it makes an ironic comment on our hopes for travel, not merely about this world, but away from it!

We were, of course, particularly sorry to be denied the experience of meeting Prof. Oberth, and also M. Esnault-Pelterie, who was prevented from attending by ill-health. However, we did meet a number of other notable personalities in rocketry, who did not attend the working-sessions of the Congress, in addition to the delegates who did. They included Dipl.-Ing. Rolf Engels (who has been prominent in German rocket developments for at least twenty years), Dr. H. Zborowzski (who was in charge of the B.M.W. Rocket Division, with Dr. Gartmann, now of the G.f.W., as his assistant), and Dr. Schrenk (who was responsible for the Heinkel "Julia" project).

Official Proceedings

30th September. The Congress opened with a public meeting at the Sorbonne, held in the magnificent Richelieu Grand Amphitheatre and attended by over 1,000 people. Before this, the delegates were interviewed by journalists (who were well in evidence throughout the Congress), in an ante-room (again of palatial proportions). Together with several other delegates, I gave a short talk for the French Overseas Radio Service, who were also there, complete with microphones, recording equipment, etc.

At this opening meeting, the Chair was taken by M. Henri Mineur, Director of the French Institute of Astrophysics, who was supported by an impressive Committee of Honour of eminent French scientists, etc., among them M. André Hirsch (of the REP-Hirsch Prize). M. Mineur gave a talk explaining the sound scientific basis of projects for space-flight; he was followed by Mme. de Vendeuvre, Directoress of the French airborne Red Cross organisation, who expressed her

confidence that astronautics would follow on as a natural development of aeronautics.

M. Ananoff then introduced the heads of the various national delegations, who all gave brief addresses to the audience. Since members will no doubt want to know what was said on behalf of the B.I.S., my own contribution is reproduced below:—

"For centuries Man has dreamed of leaving this planet and voyaging to other worlds. Ancient myths as well as fantastic fiction of more modern times pay tribute to his curiosity on this subject, and to his deeply-felt desire to experience this exciting new adventure into the unknown. Until our own century, however, these things seemed destined to remain as dreams, forever beyond the reach of Man. Now we know better.

With the turn of the century, there came a realisation that rocket propulsion offered a means of escape from the Earth. We already had a machine which could, in theory, do the job. Pioneer thinkers in many countries (for example, Esnault-Pelterie here in France) appreciated this fact and worked hard to convince the world that interplanetary travel could, in fact, be achieved one day, and not merely dreamed about. Together with groups of amateur experimenters, they laid the foundations of the great science of rocketry which must be built up before the dream can be fully realised. All this was in pre-war days, and then—as everyone knows—the war brought a truly amazing technical progress in rocket design, achieved mainly by the Germans.

The rocket shares with almost all other branches of technology the sad fate of having been mis-applied by Man for waging war. Nevertheless, the ultimate and greatest application of the rocket—its most important eventual use—will be as the vehicle for interplanetary flight by human crews.

The British Interplanetary Society, on whose behalf I now speak, is convinced that this is so. We do not believe that this epoch-making achievement will come to pass very quickly; we do not think that Man will be able to fly to the Moon or Mars within the next five or ten years. Moreover, when these things are *possible, it will not be as the result of the work of any single inventor, or even any single small group of men. The whole development will be one of gradual evolution, just as aviation was, absorbing the efforts of a great many men in many different countries, and also the results of much work carried out, in the first place, for reasons quite different from any interest in interplanetary flight.*

It may be thirty, forty, or even fifty years hence that Man first lands on the Moon, but we know already that it is possible. Only the extension and improvement of existing techniques are required; much further knowledge is needed, but the basic principles are already known. Today, most scientists who have considered the problem at all, would accept this statement quite seriously. Only fifteen years ago, it was very different, but the technical advances of the war period, such as the V.2, provided the best possible practical answer to the sceptics.

The question that we of the British Interplanetary Society are most often asked now is not "How do you think it will be possible to fly to the planets?", but "Why do you want to do so?" One can give a long and detailed answer to this, enumerating all the new scientific knowledge which would result from interplanetary flight, and

pointing out that experience shows that such new data invariably have a real practical value in this modern world, even though this value is often not apparent in the early stages. One can explain, too, the several "commercial" uses which may be foreseen for spaceships and space-stations—as meteorological observatories and radio-relay stations beyond the atmosphere—and so on. Military considerations may also be eventually involved.

All these are quite honest answers to the question, but they are not really the fundamental one. That is to be found in the fact I have already mentioned, in the long-standing interest of humanity in the idea of space-flight. It is the greatest adventure awaiting mankind, and it is relatively soon to be lifted from the pages of fiction into the realm of fact. There are just as good reasons for wanting to explore the Universe as there were for exploring our own planet. Basically, they are the same reasons, and they will have the same sort of practical results—the discovery and application of new things of which we cannot begin to conceive. Our whole outlook cannot fail to be profoundly affected, when our own terrestrial affairs are viewed for the first time in their true perspective. It may be that, by providing a new outlet for his energies, space-travel may put an end at last to Man's disastrous wars.

The citizens of some more enlightened future age will understand these attitudes, accept them, and devote the necessary effort to building spaceships for interplanetary exploration. They will then reap the benefit of an expansion in the whole field of human activity, greater, perhaps, than the Renaissance. It should not be forgotten that that great period, also, was preceded by an age of physical exploration, when men sought out new places in ships of a very different kind. In the British Interplanetary Society, we try to give these ideas as wide an expression as possible.

There is another equally important aspect of the work of an astronautical society, and in this we are also very actively engaged. This is to contribute to the extension of technical knowledge which must occur before space-flight becomes finally and completely practical. For example, we point out the relevance to astronautics of various advances made in other less visionary fields of more immediate practical importance, such as aviation. Again, many branches of the subject are of too long-term a nature for much serious work to be done on them yet, except by a society existing specifically for the purpose: one may cite the cases of nuclear-powered rockets and the optimum orbits for interplanetary navigation. All these studies provide technical papers for our Journal.

Work of all these kinds is now going on all over the world in societies such as our own B.I.S. So far, it is unobtrusive, and the world has not taken much notice. But the ideas are spreading, so that one day—perhaps a generation hence—the world will find it has to take notice and that it wants to do so. Obviously, close co-operation between astronautical pioneers in all countries is most desirable for the faster progress of our movement. That is why international conferences like this present Congress are so valuable. They are nothing less than a meeting-place for minds which are filled with some of most revolutionary technical and philosophical ideas in the world today. We all hope for great things from the exchange of such ideas which will be taking place during the next few days."

Finally, two films were shown. The first of these was an excellent silent film of the V.2 launchings at White Sands, made by the American Army, and

the second was the well-known "Destination Moon." Although the acoustics of the Richelieu Amphitheatre left something to be desired, the latter was very well-received by the audience. Its imminent public showing in France should help the cause of astronautics there, as it has done elsewhere.

1st October. On the morning of this day, with Dr. Loeser in the Chair, a private working session was held in the French Aero Club. This was opened by Herr Koelle reading a short paper on the functions of an astronautical society, with which we found ourselves in very substantial agreement. (Incidentally, all contributions to the discussions were translated into French, English, and German—the services of Dr. Cap of Austria, and of Dr. Loeser and Herr Koelle of Germany, in addition to the official interpreters, were invaluable in this connection.)

I then spoke on the methods of the B.I.S., and M. Ananoff stressed the need for an authoritative body to speak for astronautics in every country. All delegates were agreed that it was desirable for there to be only *one* society in any single country, and all were in favour of some organisation for international co-operation between the national societies.

Dr. Rückert of Austria read a paper which advocated the formation of a European federation of national societies, having a powerful governing body, and associated with a financial holding corporation which could actually pay for large-scale experimental work.

We thought this proposal to be attractive enough in theory, but quite impracticable, and suggested instead some less rigorous form of federation of autonomous national societies, without the ambition to enter into expensive constructional activities. The German viewpoint was very close to our own, and in the end it was unanimously agreed that something along these lines should be inaugurated. M. Budry (of the G.A.F.) stressed that the body should be international, rather than merely European, if possible, and was opposed to including a commercial element.

In the afternoon, a visit was paid by the delegates to the Observatory at Meudon, where some very fine work is done on, especially, solar astronomy.

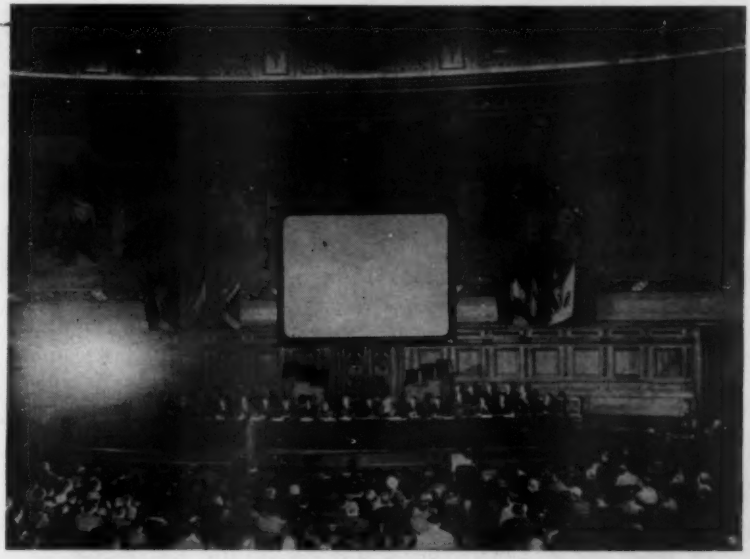
2nd October. In the morning, again at the Aero Club and this time with myself in the Chair, a second working session was held.

This began with some further discussion of the previous day's business. It was very clear that most delegates were extremely anxious for some tangible result to emerge from the present Congress, and after some more exchange of views, a resolution regarding the provisional establishment of an international federation was agreed. A translation of this resolution is given later; it was also agreed that the full details of the functioning of the federation would be discussed before the next Congress, which would be organised by us in London next year. We asked the various national societies represented to send us their proposals by the end of this year, covering such points as:—

(*a*) Constitution of the permanent Committee of the Federation.

(*b*) Voting procedure to be adopted by this Committee, with some regard to membership figures for the constituent societies.

(*c*) Organisation requiring to be set up for collaboration in technical studies, exchange of publications, etc.



The opening meeting of the Paris Congress, held in the magnificent Richelieu Amphitheatre of the Sorbonne, on 30th September. The heads of the various national delegations are seen seated at the large table on the platform, together with the Committee of Honour. Other delegates are seated behind this table, while in the foreground are some of the more than 1,000 public visitors. Prominent in this picture is the screen on which the films were presented, while the bright lights are the result of the presence of French newsreel and television cameramen.

It was hoped that all these details could be substantially agreed during the ensuing year, so that the formal business at London could be transacted quickly and the permanent federation officially inaugurated.

As regards the London Congress, it was agreed this should be in early September, 1951, subject to available dates for halls, and should last for about four days, with a break of one day in the middle. The first part of the Congress should be devoted to procedural matters, and the second to the reading of technical papers on the general theme of the artificial satellite rocket. During the first part, however, there would also be a session on the standardisation of rocket nomenclature and symbols; delegates were asked to send their proposals on this point, together with suggestions for papers to be read on the satellite rocket, to our Dr. Shepherd, who would co-ordinate them. During the second part of the Congress, it was also agreed that there should be one public session on a more popular level, at which the various national societies would explain their individual views of the technical lines along which space-travel would be realised.

During the afternoon, a visit was paid by the delegates to the atomic pile

Scene at the first work-session of the 1950 Paris Congress, on October 1. At the head of the table are M. Ananoff (in dark suit) and Dr. Loeser of the Stuttgart G.f.W. Dr. Loesser took the chair at this session; on his left are: Herr Koelle and Dr. Brugel (also of Stuttgart), Herr Oesterwinter and Herr Jungklaass (of the Hamburg G.f.W.), and our own Mr. Humphries. At the bottom right-hand corner of the picture, with back to camera, is Dr. Cap of Austria, and reading up the table (towards M. Ananoff) are: Ing. Nebel (Germany), Dr. Sanger and Frau Dr. Bredt (now resident in France), Ing. Schmiedl (Austria), Dr. Rückert (Austria), Senor Mur (Spain), Dr. Hansen (Denmark), and Prof. Tabanera (Argentine).

at Chatillon. Known as "ZOË," this pile is of the uranium oxide-heavy water type; scientists in charge of its working explained this to us, and altogether the excursion (made in a luxurious motor-coach provided by the G.A.F.) was a most interesting one.

In the evening, a final short working session was held back in the Aero Club. Messages were sent to all delegates who had been unable to attend, parting good wishes were exchanged, and the final text of the resolution drafted that morning was approved. The latter was subsequently issued to the Press by M. Ananoff; an English translation follows:—

RESOLUTIONS

The delegates participating in the First International Astronautical Congress announce with great pleasure that the meetings of 1st and 2nd October, 1950, held in private session at the French Aero Club, have resulted in a strengthening of the bonds of friendship and fraternity which give a definite promise of closer collaboration between the different national astronautical associations.

The following decisions were taken by a unanimous vote:—

1. *The creation of an international organisation for the study and development of interplanetary flight.*

2. *Having regard to the short time available for discussion and the difficulty of inaugurating an organisation of such importance, it was decided that it would not be started until next year, during the Second International Astronautical Congress.*

3. *This Congress will be held in London, in September,* 1951.

4. *As from the present date, the delegates of each country represented will send to the organisers of the Second International Congress at London their suggestions and proposals concerning the foundation of an international organisation.*

5. *The British Interplanetary Society agreed to collect, co-ordinate and distribute all the proposals which will be sent to them in this way.*

6. *The delegates undertook to study in advance all the details and proposals which will be made to them, with the object of minimising as much as possible the work, and avoiding useless discussion, during the London Congress.*

7. *It will not be until the International Astronautical Congress at London that the final decisions will be taken concerning the functioning of an "International Federation of Astronautical Societies." Its inauguration will then be formally proclaimed.*

8. *Until the creation of this international organisation, it has been decided that a provisional body, an international Bureau, shall be set up, having for its chief a neutral member: Dr. Eugen Sänger, and for members of its Committee the chiefs of the delegations represented at the First International Astronautical Congress, of whom the names follow:—*

(*SIGNED*)	*Argentine*	*Prof. Tabanera.*
	Austria	*Dr. Cap.*
	Denmark	*Dr. Hansen.*
	France	*M. Ananoff.*
	Germany	*Dr. Loeser.*
		Herr Jungklaass.
	Great Britain	*Mr. Cleaver.*
	Spain	*Senor Mur.*
	Sweden	*Ing. Hjertstrand.*

Paris, 2nd October, 1950.

Conclusion

It remains only for me to re-iterate the friendly and hopeful spirit in which all our discussions at Paris were conducted, and to express the hope that, in London next year, we shall recapture the same atmosphere. I do not believe that should be difficult to achieve; what will be more difficult will be for us to repeat the feat of M. Ananoff in organising such a splendid affair this year. The intended character of the London Congress, as you will have noticed, is rather different, with more emphasis on the technical side and rather less on the social and publicity aspects; nevertheless, I hope that all B.I.S. members will give the help they can to enable us to make London, 1951, a worthy successor to Paris, 1950.

List of Societies Interested

	Year of Formation	President* or Chairman†	Technical Director
American Rocket Society, Inc., 29, West 39th Street, New York 18, N.Y., U.S.A.	1930	William L. Gore*	Robertson Youngquist
British Interplanetary Society, 157, Friary Road, London, S.E.15.	1933 (incorporated 1946)	A. V. Cleaver†	L. R. Shepherd
Canadian Rocket Society, 58, Hilton Avenue, Toronto 10, Ontario, Canada.	1949 (Chartered)	William Cameron†	K. R. Stehling
Chicago Rocket Society, 2641, W. Haddon Ave., Chicago 22, Ill., U.S.A.	1946	N. J. Bowman*	W. A. Proell
Danish Society for Space-Travel Research, Margrethevej 1, Copenhagen, Denmark.	1949	E. Birch Anderson†	—
Detroit Rocket Society, Inc., 682, South Waterman Ave., Detroit, Michigan, U.S.A.	1946	M. G. Whybra*	D. J. Ritchie and C. E. Wilson, jnr.
Gesellschaft für Weltraumforschung e.v., Stuttgart-Zuffenhausen, Reistr. 16, Germany.	1948	Professor Oberth*	Heinz Gartzmann
Groupement Astronautique Francais de l'Aeronautique Club de France, 37, rue Lafayette, Paris.	1947	Colonel Guillet*	A. Ananoff
Nordwestdeutsche Gesellschaft für Weltraumforschung e.v., (24b) Friedrichstadt (Eider), Postfach 2, Germany.	1949	H. K. Kaiser*	G. E. Janzon
Österr Gesellschaft für Weltraumforschung Innsbruck, Austria, Innrain 29	1950	Dr. F. Cap*	—
Pacific Rocket Society (formerly South Pasadena Rocket Society), 1130, Fair Oaks Avenue, South Pasadena. Cal., U.S.A.	1945	E. V. Sawyer*	E. G. Ewing
Reaction Research Society (formerly Glendale Rocket Society), 3262, Castera Ave., Glendale 8, Cal., U.S.A.	1943	—	—
Sociedad Argentina Inter-Planetaria, C. Pellegrini 651, Buenos Aires, Argentina, South America.	1948	T. Tabanera*	Ovidio Martinez
Sudwestdeutsche Gesellschaft für Weltraumforschung e.v., Frankfurt-Main 13, Falkstrasse 77, Germany.	1947	Dr. J. W. Goethe*	W. Jung
United States Rocket Society, Inc., Box 29, Glen Ellyn, Illinois, U.S.A.	1942	R. L. Farnsworth*	—
Vereinigte Astronautische Arbeitsgezeinschaften, Leipzig (10b), N22 Bader Str.2, Germany—Russian Zone.	1948	H. Ruppe†	N. Litterst

IN SPACE-FLIGHT

Secretary	Publication(s)	Frequency of Appearance	Format	Average No. of Pages	No of Members at 30/9/1950 (approx.)	Grade of Membership	Subscription Rates
A. C. Slade	*Journal of the American Rocket Society*	Quarterly	Printed	48	1,002	(a) Active (b) Associate (c) Student	$10.00 p.a. $10.00 ,, $5.00 ,,
L. J. Carter	(a) *Journal of the British Interplanetary Society* (b) *Annual Report and List of Members*	Bi-monthly Annually	Printed Printed	48 40	925	(a) Fellows (b) Members	£2 2 0 ,, £1 0 0 ,,
H. H. Diamond	*C.R.S. Newsletter*	Bi-monthly	Duplicated	8	70	(a) Sustaining (b) Senior (c) Junior	$10.00 ,, $5.00 ,, $1.00 ,,
G. A. Whittington	*Journal of Space Flight*	Monthly	Duplicated	12	50	(a) Active (b) Associate	$5.00 ,, $3.00 ,,
L. Hansen	—	—	—	—	25	Membership	12 kroner ,,
N. F. Lazo	(a) *Rocketscience* (b) *Bulletin*	Quarterly Irregular	Duplicated —	25	40	(a) Active (b) Associate	$5.00 ,, $3.00 ,,
H. H. Kölle	*Beitrage zur Weltraumforschung*	Bi-monthly	Printed	20	317	(a) Members (b) Students	12 marks ,, 8 marks ,,
M. Gras	*Astronef*	—	Printed	12	240	—	—
R. J. Rudat	(a) *Benachrichtigungen* (b) *Vortragsreihe*	Bi-monthly Quarterly	Duplicated Duplicated	— —	Not known	Membership	6 marks ,,
Ing. Rückert	—	—	—		50	Membership	12s. ,,
R. W. MacCarthy	(a) *Pacific Rockets* (b) *Bulletin*	Quarterly Bi-monthly	Printed Duplicated	16 4	129	(a) Active (b) Associate (c) Corresponding	$12.00 ,, $12.00 ,, $5.00 ,,
—	*Astro-Jet*	Quarterly	Duplicated	24	—	—	—
R. Martinez de Vedia	—	—	—	—	60	Membership	$10.00 ,,
L. Dexheimer	*Rundschruben*	Irregular	Duplicated	—	Not known	Membership	12 marks ,,
R. H. Swenson	*Rockets* (temporarily suspended)	Quarterly	Printed	12	700	Membership	$3.00 ,,
R. Köhler	*Ad Astra*	Every six weeks	Duplicated	15	100	Membership	20 marks ,,

The British Interplanetary Society

(Limited by Guarantee)

INCOME AND EXPENDITURE ACCOUNT for the year ended 30th September, 1950.

1949	*Expenditure.*	£ s. d.	£ s. d.
£			
	To Management Expenses—		
44	Printing and Stationery ..	144 13 4	
91	Postage, Telegrams and Telephone	135 12 8	
—	Insurance	2 2 3	
29	Publicity and Advertising ..	52 6 9	
4	Library Expenses	21 0 2	
4	Bank Charges and Loss on Exchange	6 3 10	
5	Clerical Assistance	13 3 1	
8	Travelling and Entertaining Expenses	4 2 11	
18	Sundry Expenses	20 11 6	
203			399 16 6
8	,, **Accountancy and Audit** ..		8 8 0
	,, **Publications—**		
639	Six Journals and index ..	886 2 2	
57	1949 Annual Report	62 17 10	
4	Book Lists	10 18 6	
—	Lecture Notes	6 1 0	
700			965 19 6
	,, **Expenses of Meetings—**		
40	London	52 7 1	
5	Manchester	10 3 3	
45			62 10 4
	,, **Depreciation—**		
15	Furniture and Equipment ..	15 17 0	
22	Library	30 13 10	
37			46 10 10
80	,, **Transfer to Subscription Reserve**		20 0 0
1	,, **Excess of Income over Expenditure** for year carried to Accumulated Fund		2 16 6
1,074			£1,506 1 8

1949	*Income.*	£ s. d.
£		
804	**By Membership Subscriptions**	1,190 17 6
38	,, **Entrance Fees**	104 10 0
65	,, **Donations**	61 1 6
38	,, **Special Donation** to cost of Projectors ..	— — —
129	,, **Sundry Receipts**	149 12 8
1,074		1,506 1 8

BALANCE SHEET as at 30th September, 1950.

BALANCE SHEET as at 30th September, 1950.

1949							1949.						
£	*Capital and Reserves.*	£	s.	d.	£	s.	d.	£	*Fixed Assets.*	£	s.	d.	£	s.	d.
	Accumulated Fund—								**Furniture and Equipment—**						
198	Balance at 30th September, 1949..	198	17	4					Balance at 30th September, 1949,						
	Add Excess of Income over Expenditure for the year to 30th Sep-							153	at cost	152	9	6			
1	tember, 1950	2	16	6				31	*Less* Depreciation to date	46	9	6			
199					201	13	10	122					106	0	0
	Compounded Subscriptions								**Library—**						
86	**Reserve Account**				104	0	0		Balance at 30th September, 1949,						
80	**Subscriptions Reserve Account**..				100	0	0	71	at cost	110	5	11			
								39	Additions during year at cost ..	84	3	1			
365	Total of Capital and Reserves ..				405	13	10	110		194	9	0			
	Current Liabilities.							49	*Less* Depreciation to date	80	1	9			
18	**Subscriptions paid in advance**	67	1	2				61					114	7	3
133	**Sundry Creditors**	183	18	0				183	Total of fixed assets ..				220	7	3
151					250	19	2		*Current Assets.*						
								20	**Sundry Debtors**	10	16	1			
								11	**Subscriptions in Arrears**	10	19	0			
								22	**Payments made in Advance** ..	33	18	0			
								86	**Establishment Fund Deposit Account**	134	0	0			
								194	**Cash at Bank Current Account** ..	245	12	8			
								—	**Cash in Hand**	1	0	0			
								333					436	5	9
516					£656	13	0	516					£656	13	0

Certified to be a true copy—

A. V. CLEAVER } *Members of the*
A. C. CLARKE } *Council.*

L. J. CARTER, *Secretary.*

REPORT OF THE AUDITOR TO THE MEMBERS OF THE BRITISH INTERPLANETARY SOCIETY

I have obtained all the information and explanations which to the best of my knowledge and belief were necessary for the purposes of my audit. In my opinion proper books of account have been kept by the Society so far as appears from my examination of those books. I have examined the above Balance Sheet and annexed Income and Expenditure Account which are in agreement with the books of account. In my opinion and to the best of my information and according to the explanations given to me, the said accounts give the information required by the Companies Act, 1948, in the manner so required, and the Balance Sheet gives a true and fair view of the state of the Society's affairs as at 30th September, 1950, and the Income and Expenditure Account gives a true and fair view of the surplus of income over expenditure for the year ended on that date.

35, Brian Avenue,
Sanderstead, Surrey.

10th November, 1950.

T. W. WOODS,
Incorporated Accountant.

LIST OF MEMBERS
of
The BRITISH INTERPLANETARY SOCIETY

Membership numbers and classes are indicated against the names, which are arranged alphabetically in this list.

A

829. ABBOTT, William John — MEMBER
25, Trulock Road, Tottenham, N.17.

818. ADAMS, Edgar Hubert, *G.I.Mech.E.* — MEMBER
45, Knotts Green Road, Leyton, E.10.

801. ADDISON, Robert Edward, *A.M.I.Mech.E.* — MEMBER
69, Onslow Gardens, N.10.

436. ADKINS, Bruce Maxwell — FELLOW
15, Aldenham Road, Radlett, Herts.

512. AISTON, Alfred Colin — MEMBER
8, James Street, Scarborough, Yorks.

568. ALDERSMITH, Michael Frederick, F/O. — MEMBER
Officers Mess, R.A.F. Base, Seletar, Singapore, Malaya.

1153. ALDRICH, Frank Nathan — MEMBER
Apartado 49, Habana, Cuba.

23. ALGAR, Brian, *LL.B.* — MEMBER
5, Ambleside Avenue, Toller Lane, Bradford.

82. ALLEN, D. C. — MEMBER
11, Sherwood Road, N.W.4.

342. ALLEN, Dennis William — MEMBER
1, Poltimore Road, Guildford.

1154. ALLEN, Kenneth John — MEMBER
380, Oakleigh Road, Whetstone, N.20.

1151. ALLEN, Philip — MEMBER
Flowerdown Lodge, Littleton, nr. Winchester, Hants.

687. ALLEN, Richard Clive — MEMBER
282, Warley Road, Smethwick, 41, Staffs.

488. ALLEN Sidney, *A.M.I.Mech.E.* — FELLOW
30, The Park Paling, Cheylesmore, Coventry, Warwicks.

142. ALLISON, J. H. G. — MEMBER
59, Elm Terrace, Tividale, nr. Dudley, Worcs.

1114. ALLSWORTH-JONES, Philip — MEMBER
21, Radford Bank, Stafford.

195. ALLWOOD, Maurice Frank — MEMBER
19, Hamlet Road, Upper Norwood, S.E.19.

1155. ALWYN, Vivian Lorant — MEMBER
45, Station Road, Edgware, Middx.

977. AMBROSE, Noel — MEMBER
237, Ossington Buildings, Marylebone High Street, W.1.

526. AMIES, Peter Norman — MEMBER
4, The Circle, Cricklewood, N.W.2.

633. ANANOFF, Alexandre — MEMBER
5, Av. Mozart, Paris XVI°, France.

827. ANDERSON, Erling Buch — MEMBER
Aabakkevej 27, Copenhagen, Denmark.

727. ANDREW, Earle James — MEMBER
240, Churchill Avenue, Ottawa, Ontario, Canada.

919. ANDREWS, Alan Frank — MEMBER
6, Beaconsfield Derby Road, Fallowfield, Manchester, 14.

811. ANSELL, Edmund George, *B.Sc.*, *F.C.S.* — MEMBER
12, Mentmore Close, Kenton, Middx.

173. APPLEBY, Frank Ernest — MEMBER
28A, Chester Way, Kennington, S.E.11.

391. APPLEBY, Stephen Villiers — MEMBER
Flat 2, 23, Conduit Street, W.1.

241. APPLEYARD, Albert Henry — MEMBER
77, Greenleafe Drive, Ilford, Essex.

484. ARBOLES, Juan Z., *B.Sc.* — FELLOW
Vallgorguina, 129, 2º Barcelona, Spain.

80. ARMANDIAS, Louis S. — FELLOW
Staverton Approach, Cheltenham Road East, Gloucester.

970. ARMSTRONG, Rodney — MEMBER
6, Crescent Road, Cheadle, Ches.

894. ARNOLD, Stanley E., *B.Sc.* — FELLOW
c/o No. 33, Warkton, nr. Kettering, Northants.

554. ARTHUR, John David — MEMBER
"Waysmeet," Epsom Road, Ewell, Surrey.

169. ASHFIELD, Sidney George Norman — MEMBER
27, Woodland Road, Thornton Heath, Surrey.

388. ASHTON, Dennis, *Grad.R.Ae.S.* — MEMBER
4, Cardigan Court, Richmond Hill, Richmond.

997. ASSENHEIM, Judah Geoffrey — MEMBER
154, Hedge Lane, Palmers Green, N.13.

132. ASTLEY, William — MEMBER
Top Flat, Firfield, The Heath, Weybridge.

837. ATKEY, Frederick Sydney Clive — MEMBER
69, Knightwood Crescent, New Malden, Surrey.

357. AXTON, Edward James, *B.Sc.* — FELLOW
41, Wilmot Way, Banstead, Surrey.

B

379. BAKER, Paul William, *A.F.R.Ae.S.*, *A.M.N.Inst.E.* — FELLOW
18, Reading Road, Farnborough, Hants.

537. BALL, William Victor — MEMBER
1, Weston Avenue, Aston Brook Street, Birmingham, 6.

822. BALLANTYNE, Ernest Harold, *B.Sc.*, *Grad.I.E.E.* — FELLOW
"Ashton," Dalkeith, Midlothian.

508. BARFORD, Neil William, *A.F.R.Ae.S.* — MEMBER
30, Wolsey Road, Ashford, Middx.

228. BARNES, H. G. H., *B.Sc.* (*Eng.*) — MEMBER
66, Whitehouse Avenue, Boreham Wood, Herts.

628. BARNET, Peter Alan — MEMBER
4, St. George's House, Coptic Street, W.C.1.

1110. BARR, Frank Alfred — MEMBER
27, Harrow Road, Leicester.

1040. BARRETT, Gilbert Edward, *A.F.R.Ae.S.* — FELLOW
Pinewood Lodge, Boundary Road, Farnborough, Hants.

555. BARRETT, William George — MEMBER
13, Heversham Road, Bexley Heath, Kent.

612. BARR-WELLS, Donald Reynell, *Grad.I.E.E.*, *Dipl.For.Hse.* — FELLOW
48, Manchester Street, W.1.

1186. BASHAM, Samuel Jerome, Jnr. MEMBER
Box 295, Wickliffe, Kentucky, U.S.A.

263. BATTERSBY, A. FELLOW
203, Stifford Long Lane, Grays, Essex.

541. BAUM, Richard Myer MEMBER
Stocks Lane Post Office, 1, Dee Banks, Boughton, Chester

900. BAUMBERG, Joseph Wolf MEMBER
25, Kenneth Crescent, Willesden Green, N.W.2.

556. BAXTER, Professor Alexander Duncan, *B.Eng.*, *M.Eng.*, *A.F.R.Ae.S.*, *A.M.I.Mech.E.* FELLOW
The Vicarage, East Claydon, nr. Bletchley, Bucks.

648. BEACH, Sydney Alfred, *B.Sc.* FELLOW
"Hollydene," Caradoc Road, Aberystwyth.

99. BEADLE, Alfred Ronald MEMBER
20, Pindock Mews, Warwick Avenue, Maida Vale, W.9.

1131. BEANEY, Derek Neville MEMBER
183, Chalkwell Road, Sittingbourne, Kent.

76. BEAUCHAMP, Geoffrey Thomas MEMBER
62, Hook Road Bungalows, Ampfield, nr. Romsey, Hants.

695. BEDDALL, Stanley Ernest, *A.F.R.Ae.S.* FELLOW
21, Manor Drive, Aylesbury, Bucks.

386. BEEBE, Murray C. FELLOW
4300, Via Nivel, Palos Verdes Estates, California, U.S.A.

422. BEEBE, William, *Sc.D.*, *LL.D.* FELLOW
33, West 67th Street, New York City, N.Y., U.S.A.

790. BEECH, Alan Bernard MEMBER
48, Twyning Road, Stirchley, nr. Birmingham, 30.

1041. BEEHL, Charles Donald MEMBER
283, Twentywell Lane, Bradway, Sheffield.

1187. BEESLEY, Basil William MEMBER
80, Woodham Lane, New Haw, Weybridge, Surrey.

872. BEESTON, Bernard Harold MEMBER
1, Baronet Grove, Tottenham, N.17.

17. BEIN, Charles MEMBER
55A, St. John's Wood High Street, N.W.8.

715. BELL, Basil Edward MEMBER
BM/BASELL, W.C.1.

293. BENNETT, A. J. R. MEMBER
139, Hirnley Crescent, Wolverhampton.

482. BENNETT, David Hunter, *A.M.I.Mech.E.* FELLOW
c/o Burmah-Shell, Budge-Budge, 24 Parganas, West Bengal, India.

649. BENNETT, Maxwell Bruce MEMBER
"The Grange," Barambah Road, Nanango, Queensland, Australia.

407. BENSTEAD, Leslie James, *L.Inst.P.S.* MEMBER
13, Achilles Road, N.W.6.

1042. BERESFORD, Wilfred Lawrence MEMBER
56, West Park Road, West Smethwick, Staffs.

187. BETTS, Anthony Charles George, *B.Sc.* (*Eng.*) FELLOW
114, Bowring Park Avenue, Broadgreen, Liverpool, 16, Lancs.

1036. BIRD, Brian Cecil, *B.Sc.* MEMBER
"Buena Vista," Western Villas, Ambergate, Derbys.

321. BIRTWHISTLE, John Henry MEMBER
"Chellow-Dene," 2, Princess Drive, Skipton, Yorks.

950. BLAKE, Clifford Henry — MEMBER
37, Will Crooks Gardens, Eltham, S.E.9.

396. BLEACH, Keith Stuart — MEMBER
35, Hexham Road, S.E.27.

547. BLYTHE, Robert Maurice — MEMBER
23, Westover Gardens, Gateshead, 9, Co. Durham.

405. BODDY, Peter — MEMBER
20, New House Park, London Road, St. Albans, Herts.

693. BODSWORTH, Richard James — MEMBER
60, Romany Road, Kingsley, Northampton.

489. BOIVIN, Alberic, *B.A., M.Sc. (Physics)* — FELLOW
128, Eymard Avenue, Quebec, Prov. of Quebec, Canada.

742. BOLTON, Arnold Hilton — MEMBER
22, Arlington Street, Great Lever, Bolton, Lancs.

826. BOND, Herbert Maurice Charles — MEMBER
10, Erw Wen, Rhiwbina, Cardiff.

825. BONESTELL, Chesley — MEMBER
1245, North Vine Street, Hollywood, California, U.S.A.

960. BOOR, Reginald Guy — MEMBER
17, Albert Grove, Longsight, Manchester, 12, Lancs.

634. BOOTH, Peter Rowson, *B.Sc., F.C.S.* — FELLOW
481A, Finchley Road, Hampstead, N.W.3.

544. BOOTHMAN, Miss Norah, *B.Sc., A.R.I.C., F.C.S.* — FELLOW
Luton and South Bedfordshire College, Park Square, Luton.

432. BORY, George Henri — FELLOW
55, Avenue George V, Paris, France.

15. BOULNOIS, Denis L'Estrange — MEMBER
Watermans, Henley-on-Thames, Oxon.

1188. BOWEN, Arthur Neil — MEMBER
81, Clarendon Road, Thornaby-on-Tees, Yorks.

1065. BOWMAN, Barry Dennis — MEMBER
48, Manor Drive, Wembley Park, Middx.

601. BOWMAN, Douglas Alan — MEMBER
P.O. Box 1231, Salinas, California, U.S.A.

1132. BOWMAN, Harold, *A.M.I.R.E.* — FELLOW
"Haredon," Bois Avenue, Chesham Bois, Bucks.

797. BRAITHWAITE, Richard Stanley William — MEMBER
10, Wolseley Road, Crouch End, N.8.

780. BRAUN, Professor Dr. Wernher von, *Ord. Res. and Dev. Div. Sub O (Rkt.)* — HONORARY FELLOW
Fort Bliss, Texas, U.S.A.

397. BRAVINGTON, Fruin Bruce Charles, *B.A.* — MEMBER
34, Upper Cheyne Row, S.W.3.

216. BREMNER, Kenneth John — MEMBER
26, Beaufort Gardens, Hendon Central, N.W.4.

9. BREMNER, Robert James — FELLOW
26, Beaufort Gardens, Hendon Central, N.W.4.

1156. BRERETON, Derek Henry — MEMBER
125, Westborune Grove, Bayswater, W.2.

1116. BRETTINGHAM-MOORE, Edward Anthony — MEMBER
Davan Hollow, Slade Oak Lane, Higher Denham, Bucks.

800. BREWIN, Donald Ambrose — MEMBER
169, Trent Road, Beeston, Nottingham.

1035. BRIDGFORTH, Porfessor Robert Moore, *B.Sc., S.M.* — MEMBER
Dept. of Physic, Emory-Henry College, Emory, Virginia, U.S.A.

898. BRIGGS, James — MEMBER
3, The Brow, Widley, Portsmouth, Hants.

722. BRITTAIN, P. Ian, *B.Sc.* — FELLOW
55, Wroxham Gardens, Potters Bar, Middx.

873. BROOKE, Wilfred Michael — MEMBER
31, Linton Grove, S.E.27.

561. BROOKER, Frank — MEMBER
18, Clovelly Court, Upminster Road, Hornchurch, Essex.

85. BROSAN, G. S. — FELLOW
187, Willesden Lane, N.W.6.

1100. BROUGH, Andrew — MEMBER
39, Blacklaw Road, Dunfermline, Fifeshire.

690. BROUGHTON, Leslie William, *A.M.I.Mech.E.* — FELLOW
18, Grenville Road, Southcourt, Aylesbury, Bucks.

1157. BROWN, Albert Neville — MEMBER
51, Granby Street, Princes Park, Liverpool, 8, Lancs.

523. BROWN, Arthur Stanley — MEMBER
139, Boleyn Road, Forest Gate, E.7.

1189. BROWN, David Clifford — MEMBER
49, Sydney Street, Flint, North Wales.

1032. BROWN, John — MEMBER
127, Osborne Street, Rochdale, Lancs.

1121. BROWN, John Thomas — MEMBER
47, Twybridge Way, Stonebridge Park, Willesden, N.W.10.

924. BROWN, Keith Lambton — MEMBER
7, Sandersons Yard, Loftus, Saltburn, Yorks.

991. BROWN, Norman Terence — MEMBER
13, N.I.S, Land Commissioners Office, Hanover, BAOR (5)

1133. BROWN, Robert Victor — MEMBER
14, Chapel Street, Colchester.

1134. BROWNE, Maurice Anthony, *B.A.* — MEMBER
"Pinehurst," Hillbrow, Liss, Hants.

450. BROWNE, Michael A. — MEMBER
24A, Oxford Road, Manchester, 1, Lancs.

986. BROWNING, Charles — MEMBER
34–41, 78 Street, Jackson Heights, N.Y., U.S.A.

765. BRYCE, John Hedworth — MEMBER
c/o 142, Mill Lane, St. Helens, Lancs.

705. BUCHANAN, Keith — MEMBER
Box 531, Amsterdam, Ohio, U.S.A.

471. BUKOVSKY, Jan Joseph, *A.F.R.Ae.S., D.C.A., M.I.E.T.* — FELLOW
9, Clifton Hill, Brighton, 1, Sussex.

1088. BULLERWELL, Angus Muncaster — MEMBER
69, Cuthershall Road, Blackhill, Co. Durham.

745. BULLEY, James Arthur, *B.Sc., A.R.I.C., F.C.S.* — MEMBER
11, Collingtree Road, S.E.13.

775. BULMER, Henry Kenneth — MEMBER
84, Drayton Park, N.5.

969. BURBIDGE, Anthony Richard Arthur — MEMBER
55, Thornaby Gardnes, Edmonton, N.18.

853. BURGE, Donald Richard — MEMBER
2, Gainsborough Buildings, Millbank Estate, S.W.1.

1. BURGESS, Eric, *F.R.A.S.* — FELLOW
4, Cordova Avenue, Denton, Manchester.

946. BURLEY, John William — MEMBER
17, New Street, Shipston-on-Stour, Warwicks.

327. BURNABY, Thomas Patrick, *B.A.* MEMBER
6, Hedgerley Close, Cambridge.

760. BURRAS, William John, *B.Sc.* FELLOW
2, "Glenburn," Calverley Lane, Horsforth, nr. Leeds.

1135. BURTON, James Rankin Reid MEMBER
12, Cresswell Street, Glasgow, W.2.

1106. BYRNE (Major) John Edward Gerald MEMBER
12, Overton Road, Brixton, S.W.9.

C

940. CADELL, John, *M.A.* (*Oxon.*) MEMBER
3, Prospect Place, Hampstead, N.W.3.

815. CAIRNS, John Carr, *M.A.* FELLOW
"Invercairn," Hart Road, Thundersley, Essex.

699. CAMERON, Alastair G. W., *B.Sc.* FELLOW
617, Eastlake Avenue, Saskatoon, Sask., Canada.

985. CAMERON, John Rodney Lyle MEMBER
87, Oakwood Court, W.14.

615. CANDLIN, Alfred Hugh Stanton, *B.Sc.*, *A.I.Mech.E.* FELLOW
2, Camp View, Wimbledon, S.W.19.

236. CAPLIN, Hyman Harry MEMBER
104, London Road, Clacton-on-Sea, Essex.

235. CAPLIN, Stephen Dudley MEMBER
164, Sirdar Road, Wood Green, N.22.

768. CAROLAN, Leonard Robert, *A.R.Ae.S.* FELLOW
18, Ashton Avenue, Earlwood, Sydney, N.S.W., Australia.

1094. CARTER, Carol Vivian MEMBER
8, Robinson Square, Splott, Cardiff, Glam.

1095. CARTER, Harry Charles MEMBER
Flat 4, 27, Warrington Crescent, W.9.

770. CARTER, Kenneth George MEMBER
4, Buller Road, Wood Green, N.22.

6. CARTER, Leonard James, *A.C.I.S.* FELLOW
157, Friary Road, Peckham, S.E.15.

513. CASHMORE, David John, *B.Sc.* FELLOW
61, Mundania Road, S.E.22.

549. CASIRAGHI (Ing.) Giovanni P. FELLOW
Via Galata 33–5, Genoa, Italy.

630. CAWEIN, Madison, *B.S.* (*Phy.*) FELLOW
3010½ So Calhoun, Fort Wayne, Indiana, U.S.A.

498. CHANDLER, Arthur Bertram (*Master Mariner*) FELLOW
29, Cambridge Road, Hounslow, Middx.

1009. CHANDLER, Peter James Graham MEMBER
2, Oswald Terrace, Sturton Street, Cambridge.

466. CHAPMAN, George Kenneth MEMBER
23, Farnley Road, South Norwood, S.E.25.

841. CHAPMAN, Gerald Paul Wallace MEMBER
"Briar Cottage," Burstow, Horley, Surrey.

864. CHARLES, Major Bernard Nathan, *B.Sc.* MEMBER
616, W.116th Street, New York, 27, N.Y., U.S.A.

849. CHARMAN, Frederick William MEMBER
47, Somerset Avenue, Hook, Surbiton, Surrey.

1102. CHART, Graham Reginald George MEMBER
Bramblehurst, Graylands, Horsham, Sussex.

747. CHEAL, Joseph John MEMBER
Falkland Islands Dependencies Survey, c/o Postmaster, Stanley, Falkland Islands.

294. CHRISTENSEN, Dr. Hans Christian — MEMBER
Forsvarets Forkningsinstitutt, Avd f Kjeml, Lillestrom, Norway.

704. CHRISTOPHER, Peter Alfred Thomas — FELLOW
15, Cove Road, Farnborough, Hants.

1136. CLARK, Brian Lathan — MEMBER
15, Hayton Grove, North Road, Gipsyville, Hull, Yorks.

1023. CLARK, William Robin — MEMBER
89, Parry's Lane, Stoke Bishop, Bristol, 9, Glos.

2. CLARKE, Arthur Charles, *B.Sc.* — FELLOW (LIFE)
88, Nightingale Road, N.22.

654. CLARKE, Aubrey Vincent — MEMBER
16, Wendover Way, Welling, Kent.

641. CLARKE, Edward — MEMBER
10, Brookfield Terrace, Foxdale, St. Johns, I.O.M.

90. CLARKE, Joseph Adam — MEMBER (LIFE)
15, Campden Hill Gardens, Notting Hill Gate, W.8.

1016. CLARKE, Ronald Leslie — MEMBER
196, Portland Crescent West, Stanmore, Middx.

485. CLAY, Charles Albert Thomas, *F.R.Met.S.* — MEMBER
26, Chiswick Village, W.4.

4. CLEATOR, Philip E. — HONORARY FELLOW
151, Wallasey Road, Wallasey, Cheshire.

7. CLEAVER, Arthur Valentine, *A.R.Ae.S.* — FELLOW
22, Lyndhurst Gardens, Belsize Park, N.W.3.

874. CLEMENTS, Richard James — MEMBER
36, Crescent Road, Shepperton, Middx.

609. CLIFTON, Richard — MEMBER
507, Forest Road, E.17.

311. COATES, Edmund William, *A.M.I.Mech.E., A.F.R.Ae.S.* — FELLOW
18 Helmsley Drive, West Park, Leeds, 6.

401. COBB, Flt.-Lt. Henry James — MEMBER
"The Tything," London Lane, Cuckfield, Sussex.

683. COLE, Ernest John, *Grad.I.E.E.* — FELLOW
22, Langlands Road, Glasgow, S.W.1.

956. COLE, Frederick Stanley — MEMBER
57, The Drive, Isleworth, Middx.

329. COLLINS, John — MEMBER
185, Bishopsford Road, Morden, Surrey.

650. COLLINS, John Stuart, *B.Sc., Grad.I.Mech.E.* — FELLOW
38, Fanshawe Road, Hengrove, Bristol, 4, Glos.

903. COLLINSON, David Wright — MEMBER
10, Westerfield Road, Ipswich, Suffolk.

336. CONQUEST, G. R. A., *B.A.* — MEMBER
c/o Foreign Office, 12/17 Carlton House Terrace, S.W.1.

1043. COOKE, Kenneth Steven — MEMBER
160, The Glade, Shirley, Croydon, Surrey.

1066. COOMBER, John Edmund — MEMBER
42, Maycock Road, Coventry, Warwicks.

962. COOPER, Derrick — MEMBER
278, Princes Avenue, Palmers Green, N.13.

113. COOPER, Ernest John — MEMBER
41, Merton Hall Road, S.W.19.

1122. COOPER, James — MEMBER
418, Old Kent Road, S.E.1.

979. CORDNER, Robert Bruce — MEMBER
25, Westover Road, Davyhulme, nr. Manchester, Lancs.

328. CORNTHWAITE, Leonard Thomas — MEMBER
23, Fulshaw Avenue, Wilmslow, Cheshire.

618. CORPER, Michael — MEMBER
42, Grasmere Avenue, Preston Road, Wembley, Middx.

955. CORY, Harry George — MEMBER
"Oakdene," Little Weldon, Corby, Northants.

1158. COURTIER, George Walter — MEMBER
2, Millway Avenue, Pomphlett, nr. Plymouth, Devon.

1089. COX, Edward Henry — MEMBER
117, Green Lane, Morden, Surrey.

904. CRAWFORD, Alexander, *B.Sc., Grad.I.Mech.E., Grad.I.E.E.F.* — FELLOW
27, Albert Road, Gourock, Renfrewshire.

285. CROSS, Charles Arthur — FELLOW
"Green Mount," Brockhurst Hill, Northwich, Cheshire.

899. CROSTHWAITE, Alan Milnes — MEMBER
4, Osborne Road, Stockport, Cheshire.

682. CROWE, Thomas Albert — MEMBER
14, Manor Way, Worcester Park, Surrey.

651. CROWHURST, Leslie John — MEMBER
60, Sedlescombe Road, S.W.6.

1003. CRUMP, Walter Lewis — MEMBER
76, Skidmore Avenue, Wolverhampton, Staffs.

145. CURTIS, John Gordon — MEMBER
63, Broom Avenue, Rotherham, Yorks.

D

933. DABOO, Jal Erach, *B.A., Grad.R.Ae.S.* — FELLOW
92, Ellison Road, S.W.16.

1011. DAKIN, Eric Thomas — MEMBER
24, Imperial Road, Wood Green, N.22.

427. DANDRIDGE, Michael Percy, *F.R.S.A., A.C.I.S.* — MEMBER
13, Pickhurst Rise, West Wickham, Kent.

154. DANIELS, Douglas Vincent — MEMBER
1, Junction Road, Bath, Somerset.

891. DANN, A/Cdr. Charles L.; *O.B.E., B.Sc.* — FELLOW
Church Farm, Westcott, Aylesbury, Bucks.

400. DANN, John Syer — MEMBER
The Old Rectory, Fradswell, Stafford.

784. DARBISHIRE, David Hamilton, *M.A.* (*Phys.*), *F.R.Met.S.* — FELLOW
Haileybury College, Hertford.

755. DAUWALTER, Chadwick S. — MEMBER
173, Tacoma Road, Oak Ridge, Tenn., U.S.A.

660. DAVEY, Anthony Reginald — MEMBER
c/o Miss Dewe, Winton House, Hampstead Norris, Newbury, Berks.

860. DAVEY, William George — MEMBER
23, St. John Street, Ogmore Vale, Glam.

307. DAVID, Frederick William, *A.F.R.Ae.S.* — FELLOW
34, Snowden Avenue, Caulfield, S.E.8, Victoria, Australia.

1087. DAVIES, Edward William — MEMBER
9, The Mount, New Bedford Road, Luton, Beds.

288. DAVIES, Frank Thomas, *D.C.A., Grad.R.Ae.S.* — FELLOW
15, Caldecote Gardens, Bushey Heath, Herts.

1115. DAVIS, George Brian — MEMBER
40, East Towers, Pinner, Middx.

691. DAVIS, George Sumpter Delahaye Coleridge, *A.M.I.Mech.E.* MEMBER
c/o Shell Co. (Singapore) Ltd., Shell House, Singapore, Malaya.

968. DAVISON, Ronald Mitchell MEMBER
16, Kirklee Road, Kelvinside, Glasgow, W.2.

789. DAY, George Richard Jack MEMBER
7, Broad Street, Bampton, Oxon.

992. DAY, Vivian Aveling MEMBER
54, Riggindale Road, Streatham, S.W.16.

1004. DEBOO, Derek Paul MEMBER
34, Chestnut Avenue, Acton, Wrexham, Denbighshire.

887. DEERING, Robert Basil MEMBER
3, Oak Avenue, The Ridgeway, Enfield, Middx.

182. DE KONINGH, Ir. Gerrit, *E.J. (Delft.), M.R.I.E.* FELLOW
Bosboom Foussainstr. Box 14, Dordrecht, Holland.

983. DELL, Frederick William MEMBER
56, Moss Road, Stretford, Manchester.

158. DELLENDAG, J. C. E. M. MEMBER
Statenweg 172c, Rotterdam, Netherlands.

988. DENNIS, Felix Harold MEMBER
60, St. James Street, E.17.

756. DENT, Arthur Henry James MEMBER
11, Tarset Road, Whitley Bay, Northumberland.

504. DE REUCK, Anthony Vivian Smith, *F.R.Met.S.* FELLOW
111, Onslow Gardens, Wallington, Surrey.

976. DESOUTTER, Andre Marcel, *A.F.R.Ae.S.* MEMBER
White Hatch, Oldfield Road, Horley, Surrey.

707. DESOUTTER, Denis Marcel MEMBER
Little Oak, Burney Road, Westhumble, Dorking, Surrey.

1112. DEW, Edward Bailey MEMBER
"Carrol," Golf Course Road, Brora, Sutherland, Scotland.

89. DICKHOFF, Robert Ernst, *Ph.D.* MEMBER
315E, 107 Street, New York, 29, N.Y., U.S.A.

700. DICKSON, Roger Savernake, *A.F.R.Ae.S.* FELLOW
Seascape, Hill Head, Fareham, Hants.

721. DIXON, Alan Edward MEMBER
9, Selhurst New Court, Selhurst New Road, S.E.25.

771. DOBBIE, Derek, *B.Sc. (Eng.)* FELLOW
89, St. Nicholas Street, Coventry, Warwicks.

1073. DOBSON, John MEMBER
31, St. Oswald's Street, West Hartlepool, Co. Durham.

24. DOBSON, Walter MEMBER
43, St. Bernard Road, Stockton-on-Tees, Co. Durham.

1105. DODSON, Richard S., Jnr. MEMBER
Byram Lake Road, Mount Kisco, New York, U.S.A.

686. DONALDSON, Ian Stuart MEMBER
"The Firs," Polefield, Prestwich, Manchester, Lancs.

539. DONHOU, Albert Henry MEMBER
19, Cripley Road, Cove, Farnborough, Hants.

1031. DONNER, William Robert MEMBER
1, Hardy Road, Farlington, Portsmouth.

478. DOREY, Frank Herbert MEMBER
2, East Close, Cockfosters, Herts.

942. DOUGLAS, Robert Norman MEMBER
2, Sion Court, Twickenham, Middx.

364. DOVE, Ernest Baker, *A.R.Ae.S.* — FELLOW
134, Church Hill Road, New Barnet, Herts.

610. DOW, James Parker — MEMBER
East Main Street, RFD 3, East Aurora, New York, U.S.A.

1111. DOW, John Pepperell Guthrie — MEMBER
c/o "Windy Ridge," Finchingfield, nr. Braintree, Essex.

130. DOWELL, Major William Chipchase — MEMBER
119, Watford Road, North Wembley, Middx.

736. DOWSETT, Arthur Raymond Leslie — MEMBER
32, Kings Road, Ditton Hill, Surbiton, Surrey.

805. DUNCAN, Alexander Douglas, *A.R.Ae.S.* — MEMBER
4, St. James Street, S.W.1.

912. DUNN, Alan George — MEMBER
79, Hayton Grove, Hull, Yorks.

1137. DUNNING, Arthur Gills — MEMBER
81, Second Avenue, Broadway, Blyth, Northumberland.

E

137. EAGLES, Dennis James — MEMBER
63, Matlock Road, Tyseley, Birmingham, 11.

1138. EAGLESHAM, McKinlay David Baird — MEMBER
39, Riverford Road, Pollokshaws, Glasgow, S.3.

552. EARNSHAW, Flt.-Lt. Charles Wilfred — MEMBER
319, Bedford Road, Hitchin, Herts.

303. EDWARDS, Courtenay, *Comp.R.Ae.S.* — MEMBER
Daily Mail, Northcliffe House, E.C.4.

748. EDWARDS, Peter Frederick Norman — FELLOW
7, Wavertree Road, Worthing, Sussex.

1090. ELLIOTT, Leopold Walter — MEMBER
41, Hosack Road, Upper Tooting, S.W.17.

550. ELLIOTT, Sidney William Herbert — MEMBER
297, Princes Road, Dartford, Kent.

875. ELLIS, Arthur Victor — MEMBER
9, Malden Road, Watford, Herts.

47. ELLIS, Charles Alfred Pascoe — MEMBER
37, Hurstbourne Gardens, Barking, Essex.

237. ELLIS, H. J. — MEMBER
57, Mount Pleasant, Barrow-in-Furness, Lancs.

847. ELLIS, Richard Tom Hughes — MEMBER
"Five Gables," Little Eversden, Cambs.

331. ELLISON, Robert, *A.M.I.Chem.E.* — FELLOW
86, Kingsway, Luton, Beds.

433. ELSTUB, St. John de Holt, *B.Sc.* (*Hons.*) — FELLOW
"The White House," Clent, Worcs.

844. EMSON, Ivan Cecil — MEMBER
"She-Lah," Berry Lane, Laindon, Essex.

661. ENGELHARD, Naftali Herz — MEMBER
11, Wingfield Road, Whitchurch, Cardiff.

915. ENGLAND, James — MEMBER
17, Wellington Street, Littleborough, Lancs.

831. ENGLISH, Patrick Thomas — MEMBER
12, Gordon Street, W.C.1.

777. ESNAULT-PELTERIE, Robert — HONORARY FELLOW
6, Rue Bonivard, Geneva, Switzerland.

540. EVANS, David Wilfred Shawyer, *B.Sc., A.R.I.C., F.C.S.* — FELLOW
c/o Central Y.M.C.A., Shakespeare Street, Nottingham.

1190. EVANS, George Frederick — MEMBER
13, Carlton Avenue, Clifton, Rotherham, Yorks.

1047. EVANS, Idrisyn Oliver — MEMBER
53, Waterer Gardens, Burgh Heath, Tadworth, Surrey.

291. EYRES, Bernard — MEMBER
9, Leycett Drive, Lawton Moor Road, Northenden, Manchester.

F

414. FALKNER, W/Cmdr. Harold Everitt, *B.A.* (*Cantab.*), *A.F.R.Ae.S.* — FELLOW
143, Ashby Road, Loughborough, Leics.

862. FARMER, Peter John — MEMBER
44, Nuffield Road, Court House Green, Coventry.

461. FAULCONER, Ivor Christopher — MEMBER
Little Flanchford, Leigh, Surrey.

146. FEARS, Francis Richard — MEMBER
6, Ferme Park Mansions, Ferme Park Road, Crouch End, N.8.

1020. FELIX, John — MEMBER
47, Millmark Grove, S.E.14.

845. FELL, Gordon Barry — MEMBER
5, Cutler Street, Smethwick, 40, Staffs.

996. FIELD, Frederick Douglas — MEMBER
47, Upper Brockley Road, S.E.4.

135. FIELD, Francis, J. — MEMBER
79, Lichfield Road, Sutton Coldfield, Birmingham.

174. FIELDEN, Henry Edward, *M.Inst.F.*, *M.I.B.E.* — FELLOW
"Broadlands," 6, Beulah Hill, Upper Norwood, S.E.19.

876. FIELDEN, John Henry — MEMBER
18, Chester Road, Akroydon, Halifax, Yorks.

772. FINCH, Bernard Ephraim, *M.R.C.S.*, *L.R.C.P.* — MEMBER
851, Finchley Road, N.W.11.

646. FINCH, Harold Douglas, *B.S.* — FELLOW
3722, Belvidere Avenue, Seattle, 6, Wash., U.S.A.

676. FIRSOFF, Valdemar Axel, *M.A.* — MEMBER
"Rigside," Sannox, Isle of Man.

1056. FIRTH, Rowland Ford — MEMBER
228, Stamford Street, Ashton-under-Lyne, Lancs.

1159. FITCH, John — FELLOW
14822 So. Lakewood Blvd, Paramount, California, U.S.A.

1028. FITZGERALD, Arthur Conrad — MEMBER
11, Florence Place, Perth.

506. FITZ-GIBBON, William Gerald, *A.R.Ae.S.* — FELLOW
"Stanbrook," Hunsdon, Herts.

310. FITZSIMMONS, Robert Arthur — MEMBER
c/o Clondrisse Pastoral Co., Flinders, Victoria, Australia.

26. FLANAGAN, Bernard, *B.Sc.* (*Hons.*) — MEMBER
34, Morley Road, Chaddesden, Derby.

10. FLEISHER, Cyril — FELLOW
23, Chiltern Street, Baker Street, W.1.

608. FLOWERS, Adrian John — MEMBER
47, St. David's Road, Southsea, Hants.

65. FOLEY, John, *Grad.R.Ae.S.*, *Grad.I.Mech.E.* — FELLOW
"The Oaks," Victoria Road, Farnborough, Hants.

927. FORBES, George Franklin, *B.S.* FELLOW
70A, Rodman Street, China Lake, California, U.S.A.

1160. FORBES, Raymond Horace MEMBER
223, Lincoln Hall, German Dept., University of Illinois, Urbana, Illinois, U.S.A.

548. FOSTER, Gerald Victor MEMBER
19, Salisbury Road, Barnet, Herts.

981. FOSTER, Jack MEMBER
35, Whitegate Road, Chadderton, Lancs.

982. FOSTER, Stanley MEMBER
179, Wilton Road, HR. Crumpsall, Manchester, Lancs.

1191. FOX, Patrick Charles MEMBER
22, Winchester Road, Hanworth, Middx.

785. FRANCIS, Barry MEMBER
113, Broad Lane South, Wednesfield, nr. Wolverhampton, Staffs.

787. FREEMANTLE, Reuben George MEMBER
"White House," The Soke, Ropley, nr. Alresford, Hants.

1057. FREMONT, Professor Claude, *B.A., M.Sc.* MEMBER
191 av des Erables, Quebec, P.Q., Canada.

957. FRESHWATER, Philip Rowland MEMBER
Hambros Bank Ltd., 41, Bishopsgate, E.C.2.

635. FRODSHAM, George Arthur MEMBER
31, Downhurst Avenue, Mill Hill, N.W.7.

877. FROST, Harold Lionel MEMBER
210, Fencepiece Road, Barkingside, Ilford, Essex.

925. FURLONG, Owen Desmond, *A.F.R.Ae.S.* FELLOW
"High House," Beer, Devon.

759. FYSH, W. Hudson, *D.F.C., A.F.R.Ae.S.* FELLOW
Qantas Empire Airways Ltd., Box 489, G.P.O., Sydney, N.S.W., Australia.

G

247. GARLAND, Capt. R. S. MEMBER
64A, Villiers Avenue, Mordale, Sydney, Australia.

936. GARNER, Geoffrey Michael MEMBER
151, Stanbridge Road, Leighton Buzzard, Beds.

694. GARTMANN, Heinz Alfred FELLOW
Klotzlmullerstrabe 113, Landshut (Bavaria), Germany.

5. GATLAND, Kenneth William FELLOW
17, Southcote Avenue, Tolworth, Surbiton, Surrey.

1068. GAULDER, Clifford Francis Kerry FELLOW
"La Folie," Searchwood Road, Warlingham, Surrey.

859. GEMMILL, Professor Chalmers, *B.S., M.D.* FELLOW
Dept. of Pharmacology, Medical School, University of Virginia, Charlottesville, Va., U.S.A.

528. GERARD, Vernon Bruce, *M.Sc.* FELLOW
35, Chancellor Street, Shirley, Christchurch, New Zealand.

617. GHASWALA, Soli Kaikobad, *F.R.S.A., F.R.Met.S., B.E.* (*Bombay*), "Edena," Queen's Road, Fort, Bombay, India. FELLOW

764. GIACOMELLI, Lorenzo Orestes MEMBER
Santa Fe 4124, Buenos Aires, Argentina, South America.

751. GIANNINI, Gabriel Maria, *Ph.D.* FELLOW
254, West Colorado Street, Pasadena, 1, California, U.S.A.

54. GIBB, John Robert, *A.R.Ae.S.* — FELLOW
40, Leamington Road Villas, W.11.

1107. GIBBS, Gilham Robert — MEMBER
34, Thorpebank Road, Shepherd's Bush, W.12.

692. GIBBS-SMITH, Charles H., *M.A., F.R.S.A., Comp.R.Ae.S.* — MEMBER
720, Kensington Close, W.8.

1152. GIBENS, Matteo Rudolph — MEMBER
Read Street, Levin, New Zealand.

39. GIBSON, W.A., *L.R.C.P., L.D.S.* — MEMBER
Boghead House, Bathgate, West Lothian.

40. GILBERT, Edward C. — MEMBER
11, Riddy Lane, Luton, Beds.

12. GILBERT, Lionel, *B.Sc., A.R.C.S.* — FELLOW
36, Cheyne Court, Royal Hospital Road, S.W.3.

122. GILES, Cedric — FELLOW
1005 East 40th Street, Brooklyn, 10, New York, N.Y., U.S.A.

878. GILLBE, Timothy Nigel — MEMBER
5, Vancouver Road, Edgware, Middx.

824. GILLETT, John David, *B.Sc.* — FELLOW
c/o Medical Dept., Entebbe, Uganda, B.E.A.

123. GILLINGS, Walter Herbert — MEMBER
115, Wanstead Park Road, Ilford, Essex.

424. GLASS, Jerzy S. — MEMBER
57, Philbeach Gardens, S.W.5.

496. GLENDENNING, Raymond, — MEMBER
80, Chester Road, Blackfen, Sidcup, Kent.

701. GOETHE, Dr. Johann Wolfgang — FELLOW
77, Falkstrasse, Frankfurt am Main West, Germany.

444. GORDON, John — MEMBER
105, Braidholm Road, Giffnock, Glasgow.

1096. GOUGH, Norman Frederick — MEMBER
Bungalow No. 254, No. 4 Site, Bourn Aerodrome, Bourn, Cambs.

855. GOWER, James Edward — MEMBER
1, Auckland Road, Hebburn, Co. Durham.

729. GREEN, Leslie Norman — MEMBER
4, Sea Road, Wallasey, Cheshire.

362. GREENFIELD, Anthony Aynsley — MEMBER
"Breinton," Fryern Road, Storrington, nr. Pulborough, Sussex.

147. GREENWOOD, Lawrence — MEMBER
48, Mayne Avenue, Leagrave, Luton.

300. GREENWOOD, Stuart William, *B.Sc.* — FELLOW
Box 288, MacDonald College, Province of Quebec, Canada.

835. GREGG, William Stewart, *F.S.A.A.* — MEMBER
9, Sandy Lodge Way, Northwood, Middx.

464. GRIFFITHS, John Frederick, *B.Sc.* — FELLOW
29, Ingleton Avenue, Welling, Kent.

520. GRIMSTON, Roger Anthony — FELLOW
286, Whitchurch Lane, Edgware, Middx.

803. GRISWOLD, David Eliot — MEMBER
P.O. Box 283, Wesleyan Statn, Middletown, Conn, U.S.A.

923. GROVES, Gerald Vann, *B.A.* — FELLOW
26, Osborne Road, Farnborough, Hants.

553. GROVES, Leonard Hubert — MEMBER
4, Hayne House, Penzance Place, Holland Park, W.11.

462. GUALTIERI, Lt. Angelo — FELLOW
12, Ashburnham Mansions, Ashburnham Road, Kings Road, Chelsea, S.W.3.

1083. GUIGNARD, John Charles — MEMBER
190, Ferry Road, Edinburgh, 6.

1161. GUNERIUS, Ernest le Roy — MEMBER
Pembina, North Dakota, U.S.A.

334. GUSSALLI, Ing. Luigi — FELLOW
Monte Suello 4, Brescia, Italia.

H

346. HALL, Cyril Lionel — MEMBER
29, Aspinall Road, Brockley, S.E.4.

592. HALL, Dennis — MEMBER
47, Calgary Street, Mt. Eden S2, Auckland, New Zealand.

665. HALL, Herbert — FELLOW
7, Kingsland Avenue, Oakhill, Stoke-on-Trent, Staffs.

934. HALL, James Eric — FELLOW
219, Slack Lane, Derby.

954. HALL, Peter Alexander — MEMBER
12, Gredington Street, Liverpool, 8, Lancs.

380. HAMMOND, Alfred Holmes, *A.R.Ae.S.* — MEMBER
11, Everton Road, Strathfield, N.S.W., Australia.

115. HAMPTON, Capt. Trevor Arthur, *A.F.C.* — FELLOW
34, Hinstock Road, Handsworth Wood, Birmingham.

1108. HANSFORD, Ian Victor — MEMBER
19, Meyrick Park Crescent, Bournemouth, Hants.

157. HANSON, Maurice Kimpton — MEMBER
95, Mere Road, Leicester

1162. HARKER, Philip Neville — MEMBER
14, Sissons View, Middleton, Leeds, 10.

666. HARKNETT, Richard Vernon — MEMBER
31, Vernon Drive, Stanmore, Middx.

33. HARPER, Harry — MEMBER
"Hatherton," Worple Road, Epsom, Surrey.

1044. HARPER, James, *M.B., Ch.B.* — MEMBER
55, Daisybank Road, Manchester, 14, Lancs.

262. HARPER, Richard Frederick, *Grad.I.Mech.E., Grad.I.E.E.* — FELLOW
"Rose Cottage," Chawston, Beds.

1163. HARPER, William Massie — MEMBER
"Hatherton," Cross Lane, Congleton, Cheshire.

183. HARRIS, Benjamin Denzil — MEMBER
341, Gander Green Lane, North Cheam, Surrey.

425. HARRISON, John Edgar Alfred, *B.Sc.* (*Phys.*) — FELLOW
Ministry of Supply Staff Club, Aberporth, Cardiganshire.

41. HARROP, Gerard R. — MEMBER
"La Preference," St. Martin, Jersey, Channel Islands.

92. HARTFORD, Maurice Walter, *D.F.C., A.F.R.Ae.S.* — MEMBER
10, Old Barn Close, Christchurch, Hants.

516. HARVEY, Peter John — FELLOW
41, Bressey Grove, South Woodford, E.18.

952. HASKER, Alfred — MEMBER
50, Windsor Crescent, St. James, Northampton.

843. HASSETT, Maurice M. — MEMBER
"Coosane," Birdhill, Via Limerick, Co. Tipperary, Eire.

439. HAWES, Douglas Owen, *B.Sc.* (*Eng.*), *A.M.Inst.E.E.* — FELLOW
65, Oakwood Crescent, Winchmore Hill, N.21.

1092. HAYNES, Sydney Thomas — MEMBER
122, Kirby Road, North End, Portsmouth, Hants.

178. HAZELL, William Selwyn Victor — MEMBER
Penwaurgoch House, Penturyn, Treharris, Glam.

518. HEALEY, Gordon Terry — MEMBER
23, Grove Hill, Caversham, Reading, Berks.

907. HEARN, Miss Ailcen Dulcie, *B.A.* (*Hons.*) — MEMBER
34, Hamilton Road, Ealing, W.5.

428. HEINLEIN, Robert Anson — MEMBER
1825, Cheyenne Blvd, Colorado Springs, Col. U.S.A.

538. HELLINGS, Brian, *F.R.Met.S.* — FELLOW
1565, West 13th Avenue, Vancouver, B.C., Canada.

95. HENDLEY, Kenneth Middleton — MEMBER
32, Farley Avenue, Luton, Beds.

1059. HENDRIE, Michael James — MEMBER
"Anchorage," 25 The Crossways, Westcliff-on-Sea, Essex.

728. HENNIKER-HEATON, Peter Joseph, *B.A.* (*Oxon.*) — MEMBER
14, Ladbroke Square, W.11.

594. HENRY, Irvin George — MEMBER
2438, College Avenue, Berkeley, 4, Cal., U.S.A.

823. HERBERT, Richard John, *Grad.R.Ae.S.* — FELLOW
80, York Avenue, Hayes End, Middx.

469. HERMAN, Ralph Bertrand, *Grad.I.E.E.* — FELLOW
77, Fairholt Road, N.16.

1192. HERRICK, Samuel, *Ph.D.*, *B.A.* — FELLOW
University of California, Los Angeles, 24, California, U.S.A.

265. HEWITT, S/Ldr. Anthony Henry — MEMBER
59, Hill Road, Pinner, Middx.

913. HEYS, Harry Law, *M.A.* (*Cantab.*) — MEMBER
48, Oarside Drive, Wallasey, Cheshire.

632. HIGGINS, Geoffrey Thomas — MEMBER
Flat 2, "St. Owens," Silverdale Road, Burgess Hill, Sussex.

796. HILLIARD, Mrs. Desiree — MEMBER
16, Chesterford Gardnes, N.W.3.

525. HOARE, Terence — MEMBER
86, Woolacombe Road, S.E.3.

234. HODGE, F/Lt. S.R. — MEMBER
Officers Mess, R.A.F., Watton, Norfolk.

882. HODGSON, William Douglas — MEMBER
28, Shaftesbury Street, Burnley, Lancs.

14. HOLLINGBERY, Raleigh George — MEMBER
38, West Cromwell Road, S.W.5.

993. HOLMES, Richard Tilt — MEMBER
6, St. Alban's Grove, Kensington, W.8.

206. HOOPER, Geoffrey Grant — MEMBER
c/o Lloyds Bank Ltd., 6, Pall Mall, S.W.1.

596. HOPE, Earl R. — MEMBER
305, Wilbrod Street, Ottawa, Ontario, Canada.

680. HOPE-JONES, Edward Frederick, *M.A.*, *A.M.I.Civ.E.*, *A.M.I.Mun.F.*, *F.R.A.S.* — FELLOW
68, Casino Avenue, S.E.24.

258. HORNE, George Winzar — MEMBER
45, Alderbrook Road, Clapham South, S.W.12.

577. HORNIGOLD, Major James, *A.M.I.Mech.E.* — FELLOW
11, Victoria Terrace, Victoria Street, Chesterfield, Derbys.

1164. HORTON, Murray — MEMBER
66, Vancouver Drive, Burton-on-Trent, Staffs.

932. HOSKER, Joseph — MEMBER
235, Brownedge Road, Bamber Bridge, nr. Preston, Lancs.

744. HOURIGAN, Harry Frank Derham — MEMBER
177, Scribers Lane, Hall Green, Birmingham, 28.

301. HOUTMAN, Johan H. — MEMBER
Van Leeuwenhoek singer 20, Delft, Holland.

1046. HOWE, Sydney — MEMBER
17, Salisbury Terrace, Armley, Leeds, 12.

280. HOWELL, Owen Bulmer, *M.A.* (*Oxon.*) — MEMBER
"Jacmill," Harfield, Middx.

928. HOWLETT, P/O Rex Richard, *Grad.R.Ae.S.* — FELLOW
92, Hamilton Road, Felixstowe, Suffolk.

1194. HOWNAM-MEEK, Sturges — MEMBER
"Redscar," Shorefield Crescent, Milford-on-Sea, Hants.

246. HOYLE, Eric Beverley — MEMBER
c/o E.M.I. Institutes, 10, Pembridge Square, W.2.

655. HUGGINS, Peter Joseph Gibson, *B.Sc.* (*Eng.*), *Grad.I.Mech.E.* — FELLOW
78, Broxholm Road, West Norwood, S.E.27.

242. HUGHES, David R. — MEMBER
62, Pensby Road, Heswall, Ches.

959. HUGHES, Herbert Stanley — MEMBER
218, Finch Lane, West Derby, Liverpool, 14, Lancs.

30. HUMPHRIES, John, *B.Sc.* (*Eng.*), *A.M.I.Mech.E.*, *A.F.R.Ae.S.* — FELLOW
97, Churchill Avenue, Southcourt, Aylesbury, Bucks.

445. HUNT, Horace Charles Colin, *F.R.A.S.* — MEMBER
5, Stoke Road, Aylesbury, Bucks.

446. HURDEN, Dennis, *B.A.* (*Oxon.*) — FELLOW
28, Northumberland Road, Leamington Spa, Warwicks.

723. HURFORD, James Harry — MEMBER
A.S.T. Club, Hamble, Southampton, Hants.

603. HURMAN, Brian Risdon — MEMBER
37, Upper Church Road, Weston-super-Mare, Som.

358. HURRELL, Ian Murray — MEMBER
c/o The Manager, Lloyds Bank Ltd., Highcliffe, Hants.

582. HUTCHINGS, John Brian — MEMBER
27, Elmwood Avenue, Hoole, Chester.

1045. HUTSON, Lavid James — MEMBER
27, St. Mary's Road, Luton, Beds.

I

832. ILIESCU-CONSTANTINE, Radu Mircea, *M.D.*, *M.I.C.S.* — MEMBER
53, Sutton Square, Heston, Middx.

271. INGRAM, Kenneth — MEMBER
26, Trevor Square, S.W.7.

126. IRVING, Leslie, *A.M.I.E.E.* — FELLOW
28, Cannon Hill Lane, Merton Park, S.W.20.

679. ISHERWOOD, Eric — MEMBER
128, Westdale Lane (East), Gedling, Notts.

J

945. JACKSON, Clive Geoffrey Bank — MEMBER
35, Northwood Road, Whitstable, Kent.

1074. JACKSON, Cyril — MEMBER
35, Dale Road, Boarshaw Estate, Middleton, nr. Manchester.

574. JACKSON, Francis Thomas — MEMBER
6, Colvin Road, East Ham, E.6.

1082. JACKSON, Percy — MEMBER
12, Caldecote Gardens, Elstree Road, Bushey Heath, Herts.

333. JAMES, Arthur, *Comp.R.Ae.S.* — FELLOW
87, Rawlings Road, Bearwood, Smethwick, 41, Staffs.

1123. JAMES, David Cyril Owen, *B.Pharm.* — MEMBER
112, Bramley Road, North Kensington, W.10.

1165. JAMES, Richard Anthony — MEMBER
13, Bury Road, Hemel Hempstead, Herts.

176. JEFFREYS, John Alexander David — MEMBER
2, Marchmont Gardens, Richmond, Surrey.

806. JEPPE, Carl Louis Biccard, *M.B., Ch.B. (Rand.)* — FELLOW
Sterkfontein Hospital, Box 323, Krugersdorp, South Africa.

793. JEPPE, Prof. Carl Wilhelm Biccard, *A.R.S.M., D.I.C., M.Sc.* — FELLOW
University of the Witwatersrand, Milner Park, Johannesburg, South Africa.

1199. JOHN, Mrs. Clara Louise — MEMBER
4811, Illinois Avenue, N.W., Washington, D.C., U.S.A.

938. JOHNS, Max Frederick — MEMBER
Conmar Products Corpn, 140, Thomas Street, Newark, N.J., U.S.A.

1012. JOHNSON, Arthur Robert — MEMBER
Estuary House, Estuary Road, Kings Lynn, Norfolk.

1139. JONES, Cyril Thomas — MEMBER
7, Benson Road, Croydon, Surrey.

1166. JONES, Eric — MEMBER
248, Victoria Road, Ruislip Manor, Middx.

1017. JONES, Leslie — MEMBER
63, Barcroft Street, Cleethorpes, Lincs.

816. JONES, William Ronald Blythe — MEMBER
18, The Crescent, Bedwas, Newport, Mon.

842. JORDAN, Francis — MEMBER
256B, London Road, West Croydon, Surrey,

677. JOSLIN, Douglas Hector, *Grad.I.E.E.* — FELLOW
c/o Rahman Hydraulic Tin Ltd., Intan, Perak, Malaya.

K

743. KAISER, Hans Karl — MEMBER
(21A), Brackwede (Westf.), British Zone of Germany.

885. KAMMANN WILLSON, Walter Theodor — MEMBER
P.O. Box 1891, Caracas, Venezuela, South America.

1022. KATCHOFF, Bernard Stanley — MEMBER
14, Almond Way, Bromley, Kent.

828. KEHOE, Richard Brian — MEMBER
51, Meadway, Barnet, Herts.

421. KELL, Clifford, *A.M.I.Mech.E., A.F.R.Ae.S.* — FELLOW
Technical Staff Mess, Royal Aircraft Establishment, Farnborough, Hants.

281. KEMP, Peter John, *B.Sc.* — MEMBER
The Bahrein Petroleum Co. Ltd., Awali, Bahnein Island, Persian Gulf.

716. KENNEDY, Charles — MEMBER
57, Ferguson Avenue, Renfrew, Scotland.

295. KENNEDY, Warnett, *D.A.*, *A.M.T.P.I.*, *M.I.S.A.* — MEMBER
67, Upper Berkeley Street, W.1.

1000. KERRIGAN, Joseph Anthony, *M.Sc.*, *B.Sc.* — FELLOW
1, Adelaide Terrace, Summerhill, Cork, Eire.

971. KIELMAN, Lt. Sietce Marce — MEMBER
c/o Bakkersdorplaan 3, Vlissingen, Holland.

810. KIND, Stuart Stanley — MEMBER
36, Beauvale Road, Meadows, Nottingham.

131. KINGSNORTH, Arthur — FELLOW
"Denley Cottage," Rickmansworth Road, Amersham, Bucks.

440. KINGSWELL, Harold Douglas — MEMBER
16, Sandringham Road, Watford, Herts.

1125. KIRKE, Ralph — FELLOW
22, St. Michael's Road, Houghton Regis, Dunstable, Beds.

1006. KIRKWOOD, Frederick James — MEMBER
5, Quarry Terrace, Hastings, Sussex.

1005. KITCHIE, George Edward — MEMBER
5, Mackenzie Close, White City Estate, Westway, W.12.

338. KLAPPER, Harris — MEMBER
40, Thornton Avenue, S.W.2.

902. KLYEN, Lewis Ernest — MEMBER
6, Taybridge Road, Battersea, S.W.11.

1124. KNAPP-FISHER, James Stanley — MEMBER
29, Wilton Place, S.W.1.

533. KNEWSTUB, Graham — FELLOW
57, Laurel Road, Leicester.

479. KOOY, Dr. Ir. J. M. J. — FELLOW
Valkenboschlcade, 656, der Haag, Holland.

50. KUNESCH, Anthony Martin — MEMBER
c/o 28, Alexandra Drive, Surbiton, Surrey.

998. KUNESCH, Miss Stephanie Margaret — MEMBER
28, Alexandra Drive, Surbiton, Surrey.

1054. KURTA, Sidney — MEMBER
30, Millington House, Church Street, Stoke Newington, N.16.

L

1150. LADD, Patrick James — MEMBER
"Pinetops," North Bradley, nr. Trowbridge, Wilts.

535. LANE, Dennis Edward — MEMBER
44, Hodder Drive, Perivale, Middx.

663. LANE, Sidney Melville — MEMBER
4A, Spurway Parade, Woodford Avenue, Ilford, Essex.

564. LANGFIELD, Ronald Alexander, *B.Eng.* (*Hons.*) — MEMBER
11, Rock Park, Rock Ferry, Cheshire.

1027. LANGFORD, Jack Harry — MEMBER
"Serowe," Blaby Road, Enderby, Leicester.

1167. LANGTON, Norman Harry, *M.Sc.*, *A.Inst.P.* — FELLOW
"Fern Cottage," 78, Church Street, Sutton-on-Hull, Yorks.

731. LAST, Anthony John — MEMBER
25, Hillcrest Gardens, Hinchley Wood, Esher, Surrey.

517. LATHAM, Ronald Luke, *A.M.I.Mech.E.*, *A.M.I.C.E.* — FELLOW
2, Sutton Oak Road, Streetly, Sutton Coldfield, Warwicks.

1142. LAUDERDALE, Jack Eric — FELLOW
19, Rodney Court, Hatfield, Herts.

1037. LAUGHARNE, William Arthur Esmond — MEMBER
Stone Yard House, North Road, Milford Haven, Pembs.

909. LAURILLARD, John Francis — FELLOW
48, Thrasher Road, Aylesbury, Bucks.

817. LAURMANN, Jaan Alfred, *B.A.* (*Phys.*) — FELLOW
"The Gardens," Histon Road, Cambridge.

332. LAVER, John William — MEMBER
29, Bradley Road, Luton, Beds.

34. LAWDEN, Derek Frank, *M.A.* (*Cantab.*) — FELLOW
2, Axis Road, Watchfield, nr. Swindon, Wilts.

104. LAWLER, James Ernest — MEMBER
33, Manor Way, Woodmansterne, Banstead, Surrey.

1168. LEE, Vincent William — MEMBER
13, Ashbridge Road, Leytonstone, E.11.

207. LEMAN, Roy Richard — MEMBER
1, Bromwall Road, Billesley, Birmingham.

896. LENCEMENT, Robert — FELLOW
Le Cuzeau par Plazac (Dordogne), France.

975. LEONARD, Arthur Stephen, *M.Sc.*, *B.Sc.* — MEMBER
815, Douglass Avenue, Davis, California, U.S.A.

1048. LEVENSON, Leonard Lionel — MEMBER
3127, Brookdale Avenue, Oakland, 2, California, U.S.A.

148. LEVESLEY, Mark Fletcher, *B.Eng.* — FELLOW
94, Knowle Lane, Sheffield, 11.

897. LEWIS, Francis John — MEMBER
c/o Barclays Bank Ltd., Yelverton Road, Bournemouth, Hants.

906. LEWIS, Reginald Henry — MEMBER
6, Glamorgan Terrace, Penrhiweiber, nr. Mountain Ash, Glam.

951. LEWIS, Samuel John — MEMBER
77, Whitewell Road, Greencastle, Belfast, Co. Antrim.

866. LEZARD, Cecil Victor, *B.Sc.* — FELLOW
5, Palace Court, W.2.

390. LEY, Willy — FELLOW
33–15, 81st Street, Jackson Heights, Long Island, N.Y., U.S.A.

290. LIGHTBOWN, John, *M.Inst.E.E.*, *A.M.I.Mech.E.*, *M.I.B.E.*, *A.M.I.I.A.* — FELLOW
60, Wragby Road, Linclon.

1007. LINDSAY, Donald Alan — MEMBER
4, Claxton Cottages, Shaw, Newbury, Berks.

1030. LINFOOT, Brian — MEMBER
88, Queen Victoria Street, The Mount, York.

786. LISKY, Robert — MEMBER
5, Longfield Road, Ealing, W.5.

1001. LIST, Peter — MEMBER
1, Nevern Road, Earls Court, S.W.5.

865. LLOYD, Michael Raymond — MEMBER
2, Eastland Way, Oxted, Surrey.

339. LOCKTON, Cedric Phillips, *M.Sc.*, *A.M.I.E.E.* — MEMBER
10, Cartmell Road, St. Anne's-on-Sea, Lancs.

840. LOGAN, Dennis Albert — FELLOW
62, Bushey Road, Raynes Park, S.W.20.

1169. LOVELL, Francis Peter — MEMBER
41, Browett Road, Coundon, Coventry.

889. LOVELL, Peter Gareth, *B.Sc.* (*Phys.*) — FELLOW
12, East Acton Lane, East Lane, W.3.

69. LOW, Professor Archibald Montgomery, *D.Sc.*, *A.C.G.I.*, *F.C.S.*, *F.I.P.I.*, *F.I.Arb.* — FELLOW
1, Woodstock Road, W.4.

1008. LOW, Joseph Moore — MEMBER
7, Orchard Terrace, Kilbagie, By Alloa, Clackmanns.

788. LOWDEN, John Hunter, *A.F.R.Ae.S.* — FELLOW
c/o Fairey-Clyde Aviation Co. Pty. Ltd., Special Projects Division, Box 1190 K, G.P.O., Adelaide, South Australia.

1081. LOWE, Mrs. Margaret Dignam — MEMBER
47, Harewood Avenue, Northolt, Middx.

48. LUCEY, S/Ldr. Antony George — MEMBER
The Old Hall, Birstall, Yorks.

198. LUCIEN, Capt. René, *A.F.R.Ae.S.*, *A.F.I.T.A.* — FELLOW
75, Rue Denfert Rochereau, Paris, XIV, France.

670. LUCY, Dennis Harold — MEMBER
11, Hereford Avenue, East Barnet, Herts.

68. LYON, George, *B.Sc.* (*Eng.*), *A.M.I.E.E.* — MEMBER
6, Craven Court, Greenhill Park, Harlesden, N.W.10.

M

1170. MABBOTT, Raymond John — MEMBER
78, Naseby Road, Kettering, Northants.

1064. MACDONALD, John Alexander — MEMBER
41, Victoria Crescent, Elgin, Morayshire, Scotland.

16. MACDONALD, Thomas Logie, *M.A.*, *B.Sc.*, *F.R.A.S.*, *F.R.S.E.*, *F.P.S.* — FELLOW
12, Norfolk Road, Carlisle, Cumberland.

782. MACKAY, Donald Erroll Sinclair — FELLOW
280, Kenton Road, Kenton, Middx.

502. MADDOCK, D. Peter, *B.Sc.* (*Eng.*), *Grad.I.Mech.E.*, *Dip.* (*Eng.*), *U.C.N.* — FELLOW
Rocket Propulsion Dept., R.A.E., Westcott, nr. Aylesbury, Bucks.

783. MALINA, Frank Joseph, *Ph.D.*, *M.S.*, *B.S.* — FELLOW
U.N.E.S.C.O., 19, Avenue Kleber, Paris, 16, France.

918. MANGNALL, Jon Norman, *B.Sc.* — MEMBER
505, Niagara Street, Niagara Falls, New York, U.S.A.

116. MANISTY, Major G. J. E. — MEMBER
"The Little House," Larkam, Alton, Hants.

774. MANLEY, Horace, *Ph.D.*, *B.Sc.* — MEMBER
74, Anerley Road, S.E.19.

1193. MARCHANT, David — MEMBER
12, Colson Road, Loughton, Essex.

599. MARLER, Gilbert Lee — MEMBER
74, Whateley Road, Handsworth, Birmingham, 21.

963. MARLOW, William Roy — MEMBER
14, Rose Gardens, South Ealing, W.5.

703. MARSHALL, Henry James — MEMBER
c/o 33, Colworth Road, E.11.

724. MARTIN, Jack Richard — MEMBER
120, Seventh Avenue, Manor Park, E.12.

720. MASEFIELD, Peter, *M.A.* (*Eng.*), *F.R.Ae.S.*, *Grad.I.Mech.E.* FELLOW
"Rosehill," Wray Common Road, Reigate, Surrey.

880. MASON, Alan Richard MEMBER
290, Northborough Road, Norbury, S.W.16.

105. MATHER, Mrs. Sheila Margaret MEMBER
9, Swanwick Street, Old Whittington, Chesterfield, Derbys.

1126. MATTHEWS, Edward Harry MEMBER
34, Dawson Avenue, Sutton, St. Helens, Lancs.

55. MAXWELL, John Burns MEMBER
253, Ashdale Avenue, Toronto, 8, Ontario, Canada.

475. MAXWELL, Major Leigh MEMBER
29th Field Regiment, R.A., Brancepeth, Co. Durham.

752. MAXWELL, Walter Bernerd (Jnr.) MEMBER
9, Wood Avenue, Toronto, 12, Ontario, Canada.

312. MAY, Leonard George MEMBER
127, North Road, St. Andrews, Bristol, 6, Glos.

141. MAYNARD, John Kenneth, *Grad.I.E.E.*, *Far.Hse.Dipl.* FELLOW
7, Eastbrook Road, Blackheath, S.E.3.

795. MAYO, Stanley William MEMBER
11, Colin Gardens, The Hyde, N.W.9.

1026. MCCOY, William John (Jnr.) MEMBER
20, Trowbridge Street, Cambridge 38, Mass., U.S.A.

1053. MCDOUALL, John Crichton, *M.A.* MEMBER
c/o Secretariat for Chinese Affairs, Fire Brigade Building, 1st Floor, Connaught Road Central, Hong Kong.

967. MCGREGOR, Joseph Shearer MEMBER
57, Marconi Road, Fraserburgh, Aberdeenshire.

989. MCINTYRE, James MEMBER
17, Totternhoe Road, Dunstable, Beds.

1015. MCLACHLAN, Charles MEMBER
47, Moses Street, Dingle, Liverpool, 8, Lancs.

1014. MCPHEE, John Duncan MEMBER
Air Service Training Club, Hamble, Southampton.

13. MEDHURST, Richard George, *B.Sc.* (*Maths.*) MEMBER
126, Finborough Road, West Brompton, S.W.10.

209. MEERHOLZ, Edgar Francis MEMBER
54, Downing Mansions, Eloff Street, Johannesburg, Transvaal, South Africa.

565. MELHUISH, Charles Antill, *B.Eng.*, *B.Civ.E.* MEMBER
26A, South Road, Brighton Beach, Melbourne, S.5, Victoria, Australia.

990. MELLOR, Derek Lawrence MEMBER
132, Allcroft Road, Hall Green, Birmingham, 11.

1171. MELTZER, Alan Sidney MEMBER
841, Ackerman Avenue, Syracuse 10, N.Y., U.S.A.

1172. MICHIE, Gordon Sydney Russell MEMBER
60, Wanstead Park Road, Ilford, Essex.

668. MILES, Kenneth Gordon Villette MEMBER
Fir Tree Cottage, Itchenor, Chichester, Sussex.

1070. MILLER Dan Gordon, *B.A.* (*Cantab.*), *M.B.*, *B.Chir.* MEMBER
8, Kenwell Drive, Bradway, Sheffield.

995. MILLER, Henry MEMBER
57, Boyd Street, Glasgow, S.2.

1140. MILLER, Jerry MEMBER
432, Fairmount Avenue, Davenport, Iowa, U.S.A.

802. MILLER, Richard Dennis William — FELLOW
"Seacote," The Warren, Donaghadee, Co. Down, Northern Ireland.

879. MILLER, Roderick Dudley — MEMBER
116, Rowan Road, S.W.16.

359. MILNE, Herbert Valentine Richmond, *B.A. (Oxon.)* — MEMBER
c/o Lloyds Bank Ltd., Leamington Spa, Warwicks.

304. MITCHELL, Frederick — MEMBER
11, College Court, College Crescent, N.W.3.

1067. MITCHELL, Leonard John — MEMBER
1, Bristol Avenue, Antrim Road, Belfast.

64. MOLYNEUX, W. G., *B.Sc. (Eng.)* — MEMBER
17, Fellows Road, Farnborough, Hants.

1141. MONAHAN, Richard, *M.D., C.M.* — FELLOW
c/o Royal Automoblie Club, Pall Mall, S.W.1.

675. MONK, Anthony John, *Grad.R.Ae.S., Grad.I.Mech.E.* — MEMBER
"The Anchorage," Kingsdown Road, Kingsdown, Deal, Kent.

486. MONK, Patrick William Charles — MEMBER
210, London Road, Wokingham, Berks.

890. MONTGOMERY, Edwin Copas — MEMBER
Flat 315, Harwood Court, Upper Richmond Road, S.W.15.

763. MOORAT, Alfred Joseph Gregory — MEMBER
44, Bridge Street, Walton-on-Thames, Surrey.

619. MOORE, Patrick A. — MEMBER
"Glencathra," Worsted Lane, East Grinstead, Sussex.

920. MORELAND, Miss Emily — MEMBER
3, Brompton Road, Rusholme, Manchester, 14, Lancs.

180. MORGAN, James C., *B.A.Sc., M.A.* — MEMBER
177, Keewatin Avenue, Toronto, 12, Canada.

931. MOTHERSDALE, Stanley Thomas — MEMBER
25, Bewholme Grove, East Hull Estate, Hull, Yorks.

384. MOUNTAIN, Thomas Henry — MEMBER
16, Guthrie Street, Hamilton, Lanarks.

1061. MOURITZ, Peter, *A.F.R.Ae.S.* — FELLOW
4, Wilby Mews, Ladbroke Road, W.11.

1103. MOWAT, Walter Nicolson — MEMBER
Braehead Cottage, Scalloway, Shetland, Scotland.

834. MOWFORTH, Edwin — MEMBER
134, Wimbledon Park Road, Southfields, S.W.18.

1085. MUKHERJI, Kali Krishna — MEMBER
c/o Naval Adviser to the H.C. for India, 55, Jermyn Street, S.W.1.

781. MULCAHY, James — MEMBER
19, Robert Street, Accrington, Lancs.

212. MULLERVY, John Francis — MEMBER
72, Burnt Ash Lane, Bromley, Kent.

708. MULRONEY, Edward Richard, *A.M.I.B.E.* — MEMBER
44, Bath Street, Leamington Spa, Warwicks.

664. MUNDEN, Bryan Ross Michael — MEMBER
11, Elgar Avenue, Tolworth, Surbiton, Surrey.

369. MUNRO, James Copeland — MEMBER
38, Queen's Terrace, Ayr.

1195. MUR, Thomas — FELLOW
155, Alcalá Street, Madrid, Spain.

984. MURKETT, Derrick George, *B.Sc.* (*Eng.*), *Grad.I.Mech.E.* FELLOW
Fountain House, Huntingdon, Hunts.

375. MURRAY, Frederick George MEMBER
44, Victoria Road, Barking, Essex.

659. MUSSELL, Howard J. MEMBER
206, E. Hermosa Street, Santa Maria, Cal., U.S.A.

N

341. NEALE, Alan William MEMBER
34, College Hill Road, Harrow Weald, Middx.

185. NEAT, Wilfrid Norwood, *B.A.* (*Cantab.*), *A.F.R.Ae.S.* FELLOW
70, Kingshill Avenue, Kenton, Harrow, Middx.

773. NEBBIA, Giorgio FELLOW
Via Belmeloro 4, Universita degli Studi Instituto di Merceologia, Bologna, Italy

106. NEUMARK, Otto Walter FELLOW
c/o C. A. P. Ellis, 37, Hurstbourne Gardens, New Barking, Essex.

623. NEVES, Percy Ronald Haisell FELLOW
29, Welbeck Avenue, Highfield, Portswood, nr. Southampton.

838. NEWBOLD, Douglas James Frederick MEMBER
14, Sheen Road, Richmond, Surrey.

129. NEWMAN, John Oswald Henry MEMBER
36, Bulstrode Avenue, Hounslow, Middx.

658. NEWMAN, Sir Ralph Alured, *B.A.*, *M.A.* FELLOW
11, Eastcheap, E.C.3.

947. NEWTON, Robert Henry Courteney, *M.Sc.*, *B.Sc.* FELLOW
79, Harrow View, Harrow, Middx.

1038. NICHOLSON, William MEMBER
6, Rose Crescent, Richmond, Yorks.

62. NICOLL, Norman Robson MEMBER
93, Leighswood Avenue, Aldridge, Staffs.

1075. NIMMO, Walter Rule, *M.A.* FELLOW
"Garavan," Caldwell Road, West Kilbride, Ayrshire.

1173. NOBLE, Frederick William MEMBER
20, Mill Road, Bathgate, West Lothian, Scotland.

117. NONWEILER, Terence R. F., *B.Sc.* FELLOW
4, Alexandra Close, Netley Street, Farnborough, Hants.

434. NORMAN, Derek John MEMBER
32, Hillcrest Road, Romford, Essex.

282. NORMAN-WILSON, Eric FELLOW
3E, Grove End House, St. John's Wood Road, N.W.8.

858. NORRIS, Kenneth William, *A.F.R.Ae.S.*, *Grad.I.Mech.E.* FELLOW
3, Park Road, Burgess Hill, Sussex.

371. NYE, Edwin Richard MEMBER
20, Bramley Road, Southgate, N.14.

O

734. OBERTH, Professor Hermann HONORARY
Gasthof zum Robii, Oberried/Brienzer, See, Switzerland. FELLOW

272. O'BRIEN, Peter Ivar Douglas MEMBER
Kenfield Hall, Petham, Canterbury, Kent.

1174. ODELL, Alexander Douglas MEMBER
31, Edison Road, Welling, Kent.

25. OLSVANGER, Immanuel, *Ph.D.* FELLOW
3, Gaza Road, Jerusalem, Palestine.

521. O'NIONS, Albert Edward, *A.M.I.Mech.E., A.R.Ae.S., A.M.I.A.E.* FELLOW
11, Park Close, Hampton, Middx.

515. OSBORNE, Basil Whitworth, *M.Sc., Assoc. Brit. I.R.E., Grad. Inst.P.* FELLOW
120, Corhampton Road, Bournemouth E., Hants.

973. O'SHEA, Vincent Valentine FELLOW
16, Warboy's Crescent, Higham's Park, E.4.

149. OVENDEN, Michael William, *B.Sc., F.R.A.S.* FELLOW
55, Woodlark Road, Cambridge.

1127. OVER, Charles Complin MEMBER
1, Sydenham Terrace, Fratton, Portsmouth, Hants.

P

152. PAGANINI, Dr. Robert MEMBER
Burgerheim, St. Gall, Switzerland.

52. PAGE, Ernest Basil MEMBER
2, Bedhampton Road, Bedhampton, Havant, Hants.

738. PALMER, Frederick Clement MEMBER
28, Dunley Way, Lutterworth, nr. Rugby.

1013. PALMER, Ronald Edward MEMBER
56, St. Luke's Avenue, Ilford Lane, Ilford, Essex.

467. PARISH, Ralph William MEMBER
c/o 6, Lovelace Road, East Barnet, Hets.

966. PARKS, John Barrington MEMBER
34, Arlington Drive, Carshalton, Surrey.

1143. PARSONS, Geoffrey Leonard MEMBER
c/o 33, Meakin Avenue, Stone, Staffs.

807. PARSONS, Horace Philip FELLOW
17, Pemberton Gardens, Upper Holloway, N.19.

639. PASCOE, Kenneth Langon, *B.Sc.* FELLOW
23, Fairwood Court, Wallwood Road, Leytonstone, E. 11.

750. PATCHETT, Mrs. Mary Elwyn MEMBER
10E, Nevern Place, S.W.5.

935. PATON, Fergus MEMBER
303, Killin Street, Sandyhills, Tollcross, Glasgow, E.2.

622. PATRICK, Paul J. MEMBER
5239, So Pennsylvania Avenue, Cudahy, Wisconsin, U.S.A.

697. PAUL, Rodney Alan Wyatt MEMBER
Hay Place, Binsted, nr. Alton, Hants.

888. PAULSON, Roy FELLOW
83A, Spencer Road, Belper, Derbys.

821. PAYNE, Eric Richard, *A.M.I.Mech.E., A.C.T.C.* FELLOW
48, Livingstone Road, King's Heath, Birmingham, 14.

926. PAYNE, Fred Addison (Jnr.), *B.Sc.* MEMBER
8422, Rindge Avenue, Playa del Rey, Calif, U.S.A.

833. PAYNE, John Blunden, *B.Sc., A.R.C.S., M.P.S.* FELLOW
22, St. Margaret's Road, Twickenham, Middx.

953. PEACOCK, Edmund Ferrers MEMBER
39, North Road, Brentford, Middx.

382. PEACOCK, George James MEMBER
8, Arragon Gardens, West Wickham, Kent.

761. PEAKE, Charles Walter MEMBER
c/o 10, Golf Links Avenue, Oakleigh, S.E.12, Victoria, Australia.

56. PEARCE, Donald George — FELLOW
15, Osborne Court, The Parade, West Cowes, I.W.

184. PEARSON, William Fletcher — MEMBER
3, Ecclesburn Avenue, East Park Parade, Leeds, 9.

413. PECK, Merritt Edward — MEMBER
214, Lynnwood, Lincoln Heights, Jeffersonville, Indiana, U.S.A.

737. PEDEN, Kenneth, *Grad.I.E.E.* — FELLOW
3, Upper Charleville Street, Belfast, N. Ireland.

1197. PELLEGRINI, Elio Luigi — MEMBER
50, Paisley Road West, Glasgow, S.W.1, Lanarks.

726. PEMBERTON, John Entwistle — MEMBER
47, Chorley Old Road, Bolton, Lancs.

20. PEPPER, Charles Henry, *B.A.* (*Cantab.*) — MEMBER
Mitchell Hall, College of Aeronautics, Cranfield, Bletchley, Bucks.

606. PERIDIER, Julien, *F.R.A.S.* — MEMBER
16, rue Cassette, Paris VI, France.

1029. PERKIN, Peter John — MEMBER
16, Cliveden Place, S.W.1.

1076. PERKINS, John Ewart, *A.M.I.Mech.E.* — FELLOW
New Close, Higher Odcombe, nr. Yeovil, Somerset.

819. PERRY, Michael — MEMBER
The White House, Oswaldkirk, York.

741. PESEK, Professor Rudolf — FELLOW
681, Pod vilami, Prague XIV, Czechoslovakia.

1002. PHILLIPS, Lionel Boyer — MEMBER
3, Mossbank Avenue, Vauxhall Park, Luton, Beds.

298. PIENNE, Miss Yvette — MEMBER
10, Lambolle Road, N.W.3.

355. PILLING, Frederic, *A.F.R.Ae.S.* — FELLOW
"Box Cottage," North Road, Horndean, Hants.

753. PINFOLD, Raymond Neville Francis — MEMBER
9, Stonehill Avenue, Birstall, Leicester.

702. PIRANI, Felix Arnold Edward, *B.Sc.* — MEMBER
Carnegie Inst. of Technology, Schenley Park, Pittsburgh 13, Penn., U.S.A.

779. PIRQUET, Ing. Giudo von — HONORARY FELLOW
Wien XXII, 149, Austria.

916. PITT, Angus Rayfield, *A.F.R.Ae.S.*, *Grad.I.Mech.E.* — MEMBER
Cowl Cottage, Chapel Lane, Winchcomb, Glos.

711. PITTENDRIGH, Lenus Walter Duff, *A.M.I.E.E.*, *A.M.I.Brit.-I.R.E.* — FELLOW
8, Hillside, Harwell, Didcot, Berks.

905. POLLOCK, Sidney Stephen — MEMBER
4, Laneside, Dean's Lane, Edgware, Middx.

949. POOLE, Donald Eric — MEMBER
146, Reede Road, Heathway, Dagenham.

794. PORISSE, Julien Jules — MEMBER
"Oaklands," Greenfield, nr. Oldham, Lancs.

387. PORTER, Kenneth Henry, *A.R.Ae.S.* — FELLOW
8, Green's School Lane, Cove, Farnborough, Hants.

1196. POSS, Howard L., *Ph.D.*, *M.S.*, *B.S.* — MEMBER
Upton, Long Island, N.Y., U.S.A.

944. POTTIER, Philip — MEMBER
63, Riseldine Road, Honor Oak Park, S.E.23.

1175. POWELL, John Geoffrey — MEMBER
"Broadwater," The Ridgeway, Felpham, Sussex.

545. POWELL, Michael — MEMBER
8, Melbury Road, W.14.

948. POWELL, Michael John — MEMBER
71, Wolverhampton Road, Stafford.

1052. POWER, Geoffrey Charles — MEMBER
218, Bishopthorpe Road, York.

652. POWERS, William Treval — MEMBER
422, Webster, Chicago 14, Ill., U.S.A.

972. PRESCOTT, Gerald Robert — MEMBER
5, Rustington Walk, Morden, Surrey.

1176. PRESTON, Norman Owen — FELLOW
36, Havelock Road, Luton, Beds.

710. PRICE, Derek John, *Ph.D., B.Sc., A.Inst.P.* — FELLOW
University of Malaya, Singapore, Malaya.

1117. PRICE, Frank — MEMBER
Fern Bank, Dyserth, nr. Rhyl, Flints, N. Wales.

1177. PRICE, Frederick Arthur — MEMBER
46, Emlyn Avenue, Ebbw Vale, Mon.

644. PROBSTEIN, Ronald F., *M.Sc.* (*Eng.*) — FELLOW
410–B, Devereaux Avenue, Princeton, N.J., U.S.A.

168. PROBY, Richard — MEMBER
Berry Leas, Elton, Peterborough.

566. PRUTTON, Aubrey Cyril — MEMBER
84, Monkleigh Road, Morden Park, Surrey.

965. PUDARICH, Milenco — MEMBER
Overdale Hostel, Skipton, Yorks.

226. PURCHASE, Leslie John — MEMBER
R.A.E./R.P.D., Westcott, Aylesbury, Bucks.

112. PYLE, Edward John — MEMBER
13, Dalyell Road, Stockwell, S.W.9.

Q

1144. QUINN, Derek — MEMBER
1, Council Estate, Wadworth, nr. Doncaster, Yorks.

R

573. RAMBERG, Frederick Stanley — MEMBER
21, Glendower Avenue, Broad Lane, Coventry.

283. RAMSDEN, Geoffrey Reeve — MEMBER
R.A.E./R.P.D., Westcott, Aylesbury, Bucks.

345. RAMSDEN, Philip, *B.Sc.* (*Mech.Eng.*) — FELLOW
92, St. Enoch's Road, Wibsey, Bradford.

974. RAMUS, Carl, *M.D.* — MEMBER
New Jersey State Hospital, Trenton, New Jersey, U.S.A.

884. RANSOME, Major Frederick Ronald George — MEMBER
80, Briarwood Road, Stoneleigh, Surrey.

1178. RASHLEIGH, Denis George Thomas — MEMBER
101, Capstone Road, Bournemouth.

248. RATHBONE, J. R. W. — MEMBER
13, East Front Road, Pagham Beach, nr. Bognor Regis, Sussex.

203. RECA, Jorge Felipe — MEMBER
(Ypf) Destileria Fiscal La Plata, Puerto La Plata, Argentine, S. America.

1145. REDDISH, Vincent Cartledge — MEMBER
15, Holcroft Lane, Culcheth, Warrington, Lancs.

495. REDMAN, Alan Henry — MEMBER
"Glen-Devon," Bury Street, Lower Edmonton, N.9.

1093. REECE, Dennis Reginald — MEMBER
47, Alderney Road, Mile End, E.1.

958. REED, Philip Terence George — MEMBER
53, Dongola Road, Bishopston, Bristol, 7, Glos.

324. REES, Gwilym Jenkyn — MEMBER
The Woodlands, Brynmenyn, nr. Bridgend, Glam.

808. REEVE, Joseph Robert, *LL.B.* — MEMBER
600, Kenton Lane, Harrow Weald, Middx.

863. REEVES, Donald — MEMBER
"Norwood," Gedney, Spalding, Lincs.

1179. REID, Lawrence — FELLOW
Willoburn, Ballyvester Donaghadee, Co. Down, N. Ireland.

404. REID, Vera W. (Mrs.) — MEMBER
133, Gloucester Place, N.W.1.

361. RENACRE, Basil John — MEMBER
c/o Shanghai Power Co., 181, Nanking Road, Shanghai, China.

493. RICHARDSON, Robert Shirley, *Ph.D.* — MEMBER
Mount Wilson Observatory Office, 813, Santa Barbara Street, Pasadena 4, Calif., U.S.A.

302. RICKARDS, David A. — FELLOW
212, Walnut Street, Aurora, Illinois, U.S.A.

524. RIDLEY, Cecil Lawrence — MEMBER
The Forge and Workshop (Rear of Russell Cottages), Lower Willingdon, nr. Eastbourne, Sussex.

798. RIDLEY, Peter John — MEMBER
268, Well Hall Road, Eltham, S.E.9.

501. RIEDEL, Walter Julius Hermann — FELLOW
R.A.E./R.P.D.. Westcott, Aylesbury, Bucks.

576. RIMMER, Bertrand Anthony — MEMBER
"Konistra," Westlands Road, Mytton Oak, Shrewsbury, Salop.

1055. ROBBINS, Edward Whitney, *Ph.D., B.Sc.* — FELLOW
1203, E. Columbia Avenue, Phila. 25, Pa., U.S.A.

1084. ROBERTS, Clive Michael David — MEMBER
"Beechers," 9, Cold Arbor Road, Bessel's Green, Sevenoaks, Kent.

1033. ROBERTSON, Archibald Falcon Maccoll, *M.A. (Oxon.)* — MEMBER
33, High Beeches, Chelsfield, Farnborough, Kent.

719. ROBERTSON, Ian Wedderburn Clunie, *A.F.R.Ae.S.* — MEMBER
Wendover Lodge, Welwyn, Herts.

1101. ROBERTSON, John Alexander — MEMBER
N.5, Peabody Buildings, Guest Street, E.C.1.

1019. ROBINSON, Albert Walter — MEMBER
c/o 118, Bracebridge Street, Nuneaton, Warwicks.

477. ROBINSON, Robert Theophilus — MEMBER
8, Saxon Crescent, Humbledon, Sunderland, Co. Durham.

846. ROCKMAN, Michael Anthony — MEMBER
4, Downs Road, Clapton, E.5.

1021. RODGER, Robert, *A.F.R.Ae.S.* — FELLOW
23, Thorold Road, Bitterne Park, Southampton.

551. ROELICH, Mrs. Mary Webster, *M.A.* MEMBER
3, Guildford View, Upper Hale, Farnham, Surrey.

911. ROHRER, William G., *B.A.* FELLOW
P.O. Box 16, Redlands, Calif, U.S.A.

791. ROLFE, Kenneth Frank MEMBER
12, Burgess Park Mansions, Fortune Green, N.W.6.

937. ROLTON, Derek Leon MEMBER
335, Manchester New Road, Middleton, Lancs.

127. ROSENTHAL, Dr. Fritz MEMBER
18, Spessartring, Darmstadt, U.S. Zone, Germany.

8. Ross, Harry Ernest FELLOW
National Service Hostel, Flackwell Heath, High Wycombe, Bucks.

593. ROTHERHAM, Arthur Collin MEMBER
"The Shack," Hill Lane, Bassett's Pole, Sutton Coldfield, nr. Birmingham.

688. ROWE, Lawrence Frederick William, Capt., *M.B., Ch.B.* FELLOW
Officers' Mess, Royal Victoria Hospital, Netley, Hants.

84. ROY, Archibald Edmiston, *B.Sc.* MEMBER
51, Cresswell Street, Hillhead, Glasgow, W.2.

917. ROZELAAR, Alan Jack Westell, *B.Sc.* FELLOW
77, Melrose Street, Newington, Hull, Yorks.

437. RUNDLE, Alan Trevor MEMBER
15, Byron Avenue, Balby, Doncaster.

318. RUNDLE, Maurice, *B.Sc., Grad.I.E.E., Grad.I.Mech.E.* FELLOW
15, Byron Avenue, Balby, Doncaster.

689. RUNDO, John, *B.Sc., A.R.Ae.S., A.R.C.S. A.R.I.C.* FELLOW
Ridgeway House, A.E.R.E., Harwell, nr. Didcot, Berks.

754. RUSSO, Rosario, *B.Eng.* FELLOW
328, Upper Roma Street, Brisbane, Australia.

643. RYMER, Harry R. MEMBER
Dearborn Observatory, Northwestern University, Evanston, Illinois, U.S.A.

S

465. SAGGERS, Wilfred Norman MEMBER
Sun Valley Farm, Lady Wakehurst Drive, c/o Waterfall, 5C., N.S.W., Australia.

870. SALKELD, Thomas Robinson MEMBER
185, Rooley Moor Road, Rochdale, Lancs.

181. SAMARAS, D. George M.O., *D.Sc., A.F.R.Ae.S.* FELLOW
Office of Air Research, Air Material Command, W–P–AFB, Dayton, Ohio, U.S.A.

579. SANDERS, Edward Seymour MEMBER
2, Sweet Briar Green, N.9.

1128. SANDERSON, Stanley MEMBER
16, Dagnam Drive, Sheffield, 2, Yorks.

778. SÄNGER, Dr. Ing. Eugen HONORARY
Courcelle sur Yvette, S. et O., Route de Madrid, Villa Uzan, France. FELLOW

1146. SARAVANOS, Basil, *A.F.R.Ae.S.* FELLOW
Flat 4, Donadea Lodge, West End, Southampton.

929. SARGEAUNT, James Antony Hosking, *M.A. (Oxon.), A.F.R.Ae.S.* FELLOW
24, St. George's Court, 250/262, Brompton Road, S.W.3.

766. SCAMMELL, Rodney Jack, *B.Sc.* FELLOW
35, Coolhurst Road, Crouch End, N.8.

476. SCANDRETT, Eric Vincent — MEMBER
86, Warrington Road, Ince, Wigan, Lancs.

408. SCHAEFER, Herbert — FELLOW
83–26, Vietor Avenue, Elmhurst, New York, U.S.A.

616. SCHAUB, Darwin Frederick, *B.S.* (*Mech.Eng.*) — MEMBER
85, Barrow Street, New York, 14, N.Y., U.S.A.

809. SCHLESINGER, Werner Ludwig — MEMBER
35A, Havelock Street, Port Elizabeth, South Africa.

1118. SCHMALSTIG, James Joseph — FELLOW
301, Edgewood Court, Dayton, 7, Ohio, U.S.A.

740. SCHMIDTMAYER, Josef — FELLOW
1086, Brtnicka, Prague XIV, Czechoslovakia.

153. SCHUPAK, Nathan — MEMBER
579, Fort Washington, New York, 33, N.Y., U.S.A.

1018. SCOTT, Joseph James — MEMBER
"Rabream," Leek Road, Abbey Hulton, Stoke-on-Trent.

96. SEDDON, Flt.-Lt. Harry — MEMBER
12, Eastfield, Joppa, Midlothian.

1119. SELAN, Ralph, *B.Sc.* — MEMBER
4085—1st Street, Palo Alto, California, U.S.A.

418. SENOGLES, George — MEMBER
20, Hadfield Street, Hathershaw, Oldham.

814. SERVANTES, Emilio Trillo — MEMBER
Gran Via 52, 4°, Vigo, Spain.

179. SERWACKI, Thaddeus — MEMBER
58, rue Mazarin, Paris 5, France.

1078. SHALDERS, Alan Richard — FELLOW
11, Waterloo Street, Camberwell, Melbourne, Victoria, Australia.

685. SHARP, Eric Harold, *B.Sc.* (*Eng.*) — MEMBER
"Woodview," Abbess Roding, nr. Ongar, Essex.

1147. SHAW, Brian — MEMBER
34, Galloway Drive, Clifton, Swinton, nr. Manchester.

336. SHAW, George Bernard — MEMBER
Ayot St. Lawrence, Welwyn, Herts.

18. SHAW, W. R. Courtenay — MEMBER
Whiteshoots, Bourton-on-the-Water, Glos.

620. SHEARLY, Clifford — MEMBER
19, Idmiston Road, Worcester Park, Surrey.

32. SHEPHERD, Leslie R., *Ph.D.*, *B.Sc.* — FELLOW
28, Avon Road, Chilton, Berks.

994. SHEVLIN, Peter — MEMBER
31, Reins Lee Road, Waterloo, Ashton-under-Lyne, Lancs.

454. SHIPP, Horace Frederick — MEMBER
33, Strathearn Avenue, Whitton, Twickenham, Middx.

638. SHUTE, Cyril. *B.Sc.* (*Eng.*), *A.M.I.E.E.* — FELLOW
"Merlewood," Newport Road, Stafford.

296. SILK, Barry A. G. — MEMBER
44, Croftdown Road, Parliament Hill Fields, N.W.5.

869. SIMACEK, Jaroslav Karel Hynek — MEMBER
16, Lamcote Grove, Trent Bridge, Nottingham.

435. SIMONS, C. Dewar — MEMBER
Windrode House, Seagate Road, Staten Island, 5, New York, N.Y., U.S.A.

317. SIMPSON, John Egerton, *M.A.* — FELLOW
Leighton Park School, Reading, Berks.

854. SIMPSON, John Noel Spencer, *M.B., B.S.* FELLOW
"Ding Bell," Whitfield, nr. Hexham, Northumberland.

1129. SINGH, Karpal, *B.Sc.* FELLOW
c/o W. G. Stallard, 50, Riddlesdown Avenue, Purley, Surrey.

1034 SLACK, Douglas MEMBER
164, Golders Green Road, Golders Green, N.W.11.

51. SLATER, Alan Edward, *M.A., M.R.C.S., L.R.C.P., F.Z.S., F.R.,Met.S.* FELLOW
Dell Farm, Whipsnade, Dunstable, Beds.

1148. SLATER, Donald MEMBER
27, Acanthus Avenue, Fenham, Newcastle-on-Tyne.

299. SLATER, Eliot Trevor Oakeshott, *M.A., M.D., F.R.C.P.* FELLOW
National Hospital, Queen Square, W.C.1.

453. SLATER, Jack MEMBER
5, Lochaline Street, W.6.

403. SLATER, Victor Wallace, *B.Sc., F.R.I.C., M.I.Chem.E.* FELLOW
47, Hillway, Highgate, N.6.

11. SLAZENGER, Ronald Chivas Gully, *B.A. (Eng.)* FELLOW
1, Albemarle Street, W.1.

626. SMART, Alfred Athelstan, *F.R.A.S.* MEMBER
2, Ferntower Road, N.5.

1024. SMID, Drahomir Mike MEMBER
42, Hartington Street, Derby.

588. SMITH, Lt. Antony James Richard FELLOW
"Roath," Old Winslade, Clyst St. Mary, nr. Exeter, Devon.

175. SMITH, Donald R. MEMBER
13, Church Road, Hartshill, Nuneaton, Warwickshire.

28. SMITH, Edwin James MEMBER
107, Mayfield Road, Hornsey, N.8.

367. SMITH, Frank, *A.F.R.Ae.S.* FELLOW
18, Orchard Road, Farnborough, Hants.

1058. SMITH, Kenneth Edmund MEMBER
417, Smithdown Road, Liverpool, 15.

3. SMITH, Ralph Andrew FELLOW
19, Reith Road, High Wycombe, Bucks.

910. SMITH, Raymond Percy MEMBER
1, Drummond Street, Rotherham, Yorks.

1180. SMITH, Sidney Edward MEMBER
3, Langdale Avenue, Cosham, Portsmouth, Hants.

656. SMITH, Sidney John, *Grad.R.Ae.S.* FELLOW
53, Ellerdine Road, Hounslow, Middx.

505. SNODGRASS, Richard B. MEMBER
365, East McCreight Avenue, Springfield, Ohio, U.S.A.

1091. SOANES, David Trevor MEMBER
4, Supple Close, Norwich, Norfolk.

717. SODEN, Andrew Lewis, *B.Sc.(Hons.), A.R.I.C.* MEMBER
44A, Lansdowne Road, Croydon, Surrey.

214. SOUCHOTINSKY, Gustave MEMBER
87, Avenue Jean Stobbaerts, Brussells III, Belgium.

1025. SOUCY, William Arthur MEMBER
2005, McGill College Avenue, Montreal 2, Quebec, Canada.

1130. SOUTHGATE, Peter Albert Edward MEMBER
14, Aydon Grove, Corbridge-on-Tyne, Northumberland.

510. SOUTO, Lt. Carlos Ernesto Martins MEMBER
Departamento Maritimo, Lourenco Marques, P.E.A.

1198. SPARKE, Kenneth John — MEMBER
11, Charterhouse Street, E.C.1.

914. SPITZER, Professor Lyman, *Ph.D., M.A., B.A.* — FELLOW
16, Prospect Avenue, Princeton, N.J., U.S.A.

546. SPREADBURY, Richard S. — MEMBER
273, Conway Crescent, Perivale, Middx.

1051. STAERCK, Thomas Henry, *A.M.I.E.E.* — MEMBER
1, Rainsford Avenue, Chelmsford, Essex.

1099. STANLEY, Robert — MEMBER
329, Narborough Road, Leicester.

712. STANTON, Henry K. B. — MEMBER
7, Lucas Avenue, Exeter, Devon.

625. STEHLING, Kurt Richard, *B.A. (Tor.)* — MEMBER
65, Rogers Avenue, Buffalo 11, N.Y., U.S.A.

1113. STEINER, Hugo — FELLOW
155, St. Michael's Avenue, Yeovil, Somerset.

543. STEPHEN, John Dunnett Lyon, *Grad.I.Mech.E.* — MEMBER
10, Stockethill Crescent, Aberdeen.

75. STEPHENSON, Frederick Brian — MEMBER
208, Heath Road, Higher Bebington, Wirral, Cheshire.

73. STIFF, Robert S. — MEMBER
P.O. Box 69, Salem, Virginia, U.S.A.

1080. STONE, Robert Ellis — MEMBER
5263, East First Street, Long Beach 3, Calif., U.S.A.

799. STRONG, Charles Dunwoody — MEMBER
2138, Champa Street, Denver 2, Col., U.S.A.

22. STRONG, J. G., *B.Sc., A.C.G.I., A.F.R.Ae.S.* — FELLOW
7, Selwyn Drive, Hatfield, Herts.

636. STUBBINGS, Adrian Charles — MEMBER
6, The Terrace, H.M. Dockyard, Chatham, Kent.

848. STUBBS, Robert Denison — MEMBER
40, Hawksworth Road, Horsforth, nr. Leeds, Yorks.

820. STYCHE, Donald Robert Dennis — MEMBER
12, Derwent Avenue, East Barnet, Herts.

607. SUNLEY, Henry Lambert Garbutt, *Grad.R.Ae.S.* — FELLOW
Woodfield, Fittleworth, Sussex.

908. SWIFT, Leslie, *Grad.I.Mech.E., Grad.I.Prod.E.* — MEMBER
1, Lincoln Street, Wakefield, Yorks.

37. SWIFT, Reginald David — MEMBER
152, Marrowbrook Lane, Cove, Farnborough, Hants.

586. SYKES, Egerton — MEMBER
9, Markham Square, S.W.3.

93. SYKES, Leslie — MEMBER
16, Circular Road, Denton, Lancs.

215. SYRATT, Brian Edwin, *B.Eng., G.I.E.E.* — FELLOW
G.C.R.E., Ivy Farm, Knockholt, Sevenoaks, Kent.

T

204. TABANERA, Professor Teofilo — MEMBER
Tucaman 950, Buenos Aires, Argentine.

211. TANNER, John Charles — MEMBER
"Shandon," 3, Hill Rise, Rickmansworth, Herts.

503. TARR, Graham Charles, *G.I.E.E.* — MEMBER
17, Kingsfield Road, Watford, Herts.

138. TAYLOR, Frederick Burgess — MEMBER
"Quarmby," Lisson Grove, Hale, Ches.

861. TAYLOR, John Hunter, *Grad.R.Ae.S.* — FELLOW
747, Lisburn Road, Belfast, N. Ireland

120. TEMPLE, William F. — MEMBER
7, Elm Road, Wembley, Middx.

941. TEMPLEMAN, Laurence George — MEMBER
Australian Embassy, Paris 7e, France.

1077. TERRY, James William — FELLOW
103, N. Maple Street, Polo., Illinois, U.S.A.

627. THACKRAY, Malcolm — MEMBER
"Hazelwood," Newlay Wood Avenue, Horsforth, nr. Leeds.

1181. THISELTON, Keith Raymond — MEMBER
Ashbourne Road, Strathalbyn, S. Australia.

389. THOMAS, Frederick Metcalf, *A.F.R.Ae.S.* — FELLOW
"Sea-Holme," Taunton Terrace, Avondale, nr. Auckland, New Zealand.

1182. THOMASON, Derek James — MEMBER
14, Barnstaple Road, Thorpe Bay, Essex.

901. THOMPSON, Allen Race — MEMBER
19, Park Place West, Sunderland, Co. Durham.

160. THOMPSON, Gordon Vallins Elliott, *B.Sc., A.R.C.S., F.C.S., A.R.I.C.* — FELLOW
31, Brooklands Gardens, Gidea Park, Romford, Essex.

36. THOMPSON, Leonard Napier, *B.Sc., Grad.I.Mech.E.* — MEMBER
90, Lansdowne Road, Forest Hall, Newcastle-on-Tyne, Northumberland.

964. THORBURN, Thomas — MEMBER
12, Mabel Street, Meadows, Nottingham.

939. THORNETT, Jack — MEMBER
47, King Edward Crescent, Horsforth, nr. Leeds, Yorks.

563. THORILDSSON, Sigvard Olaf Thorild — MEMBER
3, dje Longgatan 27, Gothenburg, Sweden.

519. THORNTON, Alwyne Edward, *B.Sc.* — FELLOW
40, Maudslay Road, Coventry, Warwicks.

133. TIDMAN, Derek Albert — MEMBER
24, Kingsley Road, Palmer's Green, N.13.

671. TIES, Sidney — MEMBER
5, Ash Grove, Guildford, Surrey.

322. TIMBERLAKE, Alfred Phillip — MEMBER
46, West Grove, Rhostyllen, Wrexham, Denbighs.

922. TISDALE, Edward Alban — MEMBER
80, Dartmouth Avenue, Walsall, Staffs.

1050. TOOBY, Harold — MEMBER
23, Addison Avenue, Snydale Road, Normanton, York.

222. TOPHAM, Eric — FELLOW
c/o 3, Forester Avenue, Bathwick, Bath.

1010. TOWNSHEND, Charles Bernard — MEMBER
11, Lisson Cottages, Lisson Grove, N.W.1.

851. TRANT, John Arthur — MEMBER
51, Yewfield Road, Willesden, N.W.10.

499. TREGURTHA, Kenneth Downing — FELLOW
"Tremar," Underhill Road, Stoke, Plymouth, Devon.

1183. TRENCH, Brian Henry — MEMBER
10, The Broadway, Ore, Hastings Sussex.

531. TRENCHARD, Percy — MEMBER
"Lytchett," Ravon's Road, Shoreham, Sussex.

109. TRILLE, William George — MEMBER
26, Queen's Road, Southall, Middx.

921. TUCKER, Gerald Russell — MEMBER
40, Havelock Street, Aylesbury, Bucks.

1184. TUCKER, William Charles, *Grad.I.Prod.E.* — FELLOW
101, Mitcham Road, West Croydon, Surrey.

190. TURNER, Charles Teesdale — MEMBER
65, Station Road, Sidcup, Kent.

631. TURNER, John Richard — MEMBER
42, Selbourne Avenue, New Haw, nr. Weybridge, Surrey.

930. TURNER, Walford Roy — MEMBER
14, Alexandra Terrace, Tredegar, Mon.

430. TURNPENNY, Brian — MEMBER
14, Front Lane, Cranham, Upminster, Essex.

836. TUSON, Neil Gaunson — MEMBER
92, Inverness Terrace, Bayswater, W.2.

1062. TYLER, Peter Arthur — MEMBER
37, St. Antony's Road, Forest Gate, E.7.

U

143. ULLMAN, John Talbot — MEMBER
374, Kingston Road, Ewell, Surrey.

804. UNDERWOOD, Henry — MEMBER
62, Bush Road, Buckhurst Hill, Essex.

45. UNITT, Kenneth Edward Thomas — MEMBER
67, The Mount, Cheylesmore, Coventry.

605. URRY, Norman — MEMBER
73, Abbey Road, Scunthorpe, Lincs.

481. UYTENBOGAART, Professor Johannes W. H. — FELLOW
Bloemcamplaan 34, Wassenaar, Holland.

V

1104. VAUGHAN, Frederick Albert — MEMBER
1, Cumbrian Way, Millbrook, Southampton.

393. VERHORST, Richard — MEMBER
Beukelsweg 87b, Rotterdam–W, Holland.

161. VLYMEN, David Van — MEMBER
72, Islip Gardens, Northolt, Middx.

W

164. WAINE, Eric Marshall — MEMBER
113, Erskine Road, Sutton, Surrey.

350. WALKER, Dudley Frank, *A.R.Ae.S.* — FELLOW
171, Ellerton Road, Surbiton, Surrey.

895. WALKER, Ian Frederick Macey, *B.Sc.(Eng.)* — FELLOW
"Rajputana," Waverley Road, Farnborough, Hants.

813. WALKER, Lawrence Hosier — FELLOW
Box 523 E, G.P.O., Adelaide, S. Australia.

614. WALKER, Ronald, *Comp.R.Ae.S.* — MEMBER
6, West Halkin Street, S.W.1.

871. WALKER, P/O Ronald — MEMBER
47, London Road, Ipswich, Suffolk.

442. WALLACE, S/Ldr. Richard Bruce — MEMBER
Apt. 8, 261–5 Avenue, Ottawa, Ontario, Canada.

987. WALLIN, John Douglas — MEMBER
101, Beverston Road, Paulsgrove, Portsmouth, Hants.

406. WALMSLEY, John Henry, *A.F.R.Ae.S.* FELLOW
80, Pitt's Lane, Woodley, Reading, Berks

349. WALPORT, Samuel, *L.R.C.P., M.R.C.S., L.R.F.P.S.* MEMBER
C.S. *Lady Denison Pender*, c/o Western Telegraph Co., Ltd., Caixa 453, Rio de Janeiro, Brazil, S. America.

868. WALSH, Alban, *A.F.R.Ae.S., Grad.I.Mech.E.* MEMBER
149, Eastworth Road, Chertsey, Surrey.

893. WALSH, Rodney Herbert, *A.F.R.Ae.S.* FELLOW
L.I., N.S.H.C., Bicester Road, Aylesbury, Bucks.

1071. WALTERS, Frederick James MEMBER
3, Farcroft Road, Parkstone, Dorset.

611. WALTON Peter Anderson MEMBER
"Arosa," Rumsan Road, Barnstaple, N. Devon.

839. WAREHAM, Oliver Marshfield FELLOW
63, Hounslow Road, Twickenham, Middx.

1120. WARRILOW, Thomas MEMBER
29, Tiverton Close, Aspley Estate, Nottingham.

980. WATERS, PAUL MEMBER
"Veronique," Erringham Road, Shoreham-by-Sea, Sussex.

1097. WATKISS, John MEMBER
5, Woodbine Street East, Rochdale, Lancs.

1049. WATSON, Bernard John, *A.F.R.Ae.S.* FELLOW
20, Hamlyn Avenue, Hull, E. Yorks.

583. WATSON, Henry Augustine MEMBER
24, Walnut Avenue, Alvaston, Derby.

451. WATSON, John Douglas MEMBER
c/o Lloyds Bank, Ltd., 6, Pall Mall, S.W.1.

46. WATT, George Christie, *M.A.* FELLOW
10, Albert Terrace, Aberdeen.

155. WATTS, Joseph MEMBER
45, Crescent Road, Southport, Lancs.

1079. WEBB, Reginald Ernest MEMBER
10, The Crescent, Pewsey, nr. Marlborough, Wilts.

121. WEBB, Ronald E., *B.Sc.(Eng.), A.C.G.I.* FELLOW
10, Mount Harry Road, Sevenoaks, Kent.

287. WEBSTER, Douglas, *M.A.* MEMBER
"Idlewild," Fountainhall Road, Aberdeen.

881. WEBSTER, Richard MEMBER
10, Sydenham Place, Bradford, Yorks.

713. WEEDALL, Percy Norman MEMBER
20, Palmerston Drive, Liverpool, 21.

662. WELLS, Bernard James MEMBER
26, Annandale Avenue, Bognor Regis, Sussex.

978. WESTCOTT, Maurice Edgar MEMBER
72, Thornbury Road, Isleworth, Middx.

640. WESTFIELD, Alec MEMBER
31, High Santon Villas, Appleby, Scunthorpe, Lincs.

681. WESTON, William FELLOW
34, Mimosa Street, S.W.6.

698. WHATMORE, Bernard Frank MEMBER
73, Boughton Lane, Loose, Maidstone, Kent.

892. WHEELER, William Edwin, *A.M.I.Mech.E.* FELLOW
67, Wendover Road, Stoke Mandeville, Aylesbury, Bucks.

1185 WHITE, Frederick Stanley George MEMBER
53, Battersea Park Road, S.W.8.

165. WHITE, Hugh Stanley MEMBER
Box 563, Kenya Advertising Corporation, Shell House, Nairobi, Kenya, E. Africa.

758. WHITE, Reginald Graham, *M.B., B.S.* — MEMBER
P.O. Box 84, Rusapi, Southern Rhodesia, Africa.

1069. WHITNEY, Arthur George — MEMBER
122, Tokyngton Avenue, Wembley, Middx.

151. WHOLEY, Max Wingfield, *A.M.I.Mech.E.* — FELLOW
Tarbay Lane, Oakley Green, nr. Windsor, Berks.

999. WICKENS, Alan Herbert — MEMBER
Rutland Hall, Ashby Road, Loughborough, Leics.

696. WICKS, Harold David — MEMBER
60, Melbury Court, W.8.

323. WILCOX, Arthur, *B.Sc.(Maths.)*, *B.Sc.(Econ.)* — FELLOW
466, Stone Road, Lightwood, Stoke-on-Trent, Staffs.

1149. WILD, Anthony — MEMBER
767, High Road, Leytonstone, E.11.

255. WILKINS, Henry A. — MEMBER
85, Hangleton Road, Hove, 4, Sussex.

769. WILKINS, James Humphrey — MEMBER
46, Beacon Road, Loughborough, Leics.

1086. WILKINS, Richard Girvan — MEMBER
108, Outwood's Drive, Loughborough, Leics.

735. WILKINSON, Rex Stephen — MEMBER
28, Recreation Road, Tilehurst, Reading, Berks.

1039. WILLIAMS, Geoffrey Edward, *Grad.R.Ae.S.* — FELLOW
9, Elmwood Crescent, Luton, Beds.

730. WILLIAMS, John Ames, *B.Sc.(Eng.)*, *A.M.I.Mech.E.* — FELLOW
11, Moreton End Lane, Harpenden, Herts.

672. WILLIAMS, Peter Richard Geoffrey — MEMBER
Heywood, Westbury, Wilts.

567. WILLIAMS, Ronald Sidney — MEMBER
32, Ashbourne Road, Mitcham, Surrey.

217. WILLIAMS, Robert Wesley — MEMBER
73, Holmefield Road, Liverpool, 19, Lancs.

231. WILLIAMSON, R. — MEMBER
"Rothesay," West Road, Stoney Hill, Bromsgrove, Worcs.

1060. WILLINSKI, Martin Irwin — MEMBER
42, Summer Street, Apt. 9-B, Passaic, N.J., U.S.A.

613. WILLIS, Richard Hartley — MEMBER
908, West John Street, Champaign, Illinois, U.S.A.

1063. WILSON, Geoffrey L., *M.A., B.Sc.* (*Oxon.*) — MEMBER
3, Sheridan Road, Merton Park, S.W.19.

72. WILSON, J. — MEMBER
"Arran," Nightingale Avenue, East Horsley, Surrey.

43. WILSON, Laurence, *M.A.* (*Oxon.*) — MEMBER
3, Sheridan Road, Merton Park, S.W.19.

314. WINDSOR, Maurice William — MEMBER
106, Windmill Road, Gillingham, Kent.

162. WINICK, Miss, Helen — MEMBER
12, Budleigh Crescent, Welling, Kent.

492. WADHAMS, Basil Scott — MEMBER
13, Wallasey Crescent, Ickenham, Uxbridge, Middx.

1098. WOOD, William — MEMBER
15, Hilliard's Terrace, Cowley Peachy, nr. Uxbridge, Middx.

961. WOOD, Winton Richard — MEMBER
11, Mill Street, Maidstone, Kent.

867. WOODROW, Mrs. Kathleen Mary — MEMBER
"Redleaf," Slough Road, Datchet, Bucks.

857. WOODROW, Reginald James, *B.Sc., A.M.I.Mech.E.* — MEMBER
3, Windermere Crescent, South Shields, Co. Durham.

571. WOODRUFF, Alan Ivor — MEMBER
111, Portland Avenue, Gravesend, Kent.

313. WOODTHORPE, John Malpas — MEMBER
20, Knights' Hill, S.E.27.

1109. WORLEY, Horace William — MEMBER
129, Willes Road, Winson Green, Birmingham, 18.

830. WOZNIAK, Aleksander — MEMBER
50, Jeedley Road, Pendleton, Salford, 6, Lancs.

673. WRIGHT, Harry Anthony Grosvenor — MEMBER
75, South Ealing Road, Ealing, W.5.

792. WRIGHT, Ian Brodie — MEMBER
1, Mirfield Drive, Monton, Eccles, nr. Manchester.

27. WRIGHT, Michael Stephen — MEMBER
Side Bar, Hebden Road, Haworth, Keighley, Yorks.

Y

1072. YARNOLD, Alan Denis — MEMBER
48, Mellison Road, Tooting, S.W.17.

58. YATES, Peter, *B.Sc.* — MEMBER
38, Fairfield Street, Cambridge, Mass., U.S.A.

856. YORKE, Frederick Augustus — MEMBER
97, Overstrand Mansions, Battersea Park, S.W.11.

221. YOUNG, Thomas Gregson — MEMBER
"Stathmos," Whalley Road, Gt. Harwood, Blackburn, Lancs.

Z

883. ZAIDNER, Michael Philip — MEMBER
38, Hadley Court, Cazenove Road, N.16.

542. ZUMPE, Herman Frank — FELLOW
R.A.E., Westcott, nr. Aylesbury, Bucks.

850. ZWICKY, Professor Fritz — FELLOW (LIFE)
California Institute of Technology, Pasadena 4, Cal, U.S.A.

CHANGES OF ADDRESS, ETC.

Members are requested to inform the Secretary if there are any changes or alterations which should be made to the Society's list of addresses and qualifications in order to keep the records up to date. This should be done by means of a *postcard*, as it is not sufficient to write from a new address without specifically drawing attention to the fact.

The Branch Secretary should also be notified by those members who take part in the activities of the North-Western Branch.

LIST OF PUBLIC LIBRARIES AT WHICH THE SOCIETY'S PUBLICATIONS ARE MAINTAINED

Birmingham Public Libraries, Reference Library, Birmingham, 1.
Bodleian Library, Oxford.
British Museum (Copyright Receipt Office), Bloomsbury, W.C.1.
Camberwell Public Libraries, Dulwich Library, Lordship Lane, London, S.E.22.
Cleveland Public Library, 325, Superior Avenue, Cleveland, Ohio, U.S.A.
Detroit Public Library (Technology Dept.), 96, Putnam Avenue, Detroit, 2, Michigan, U.S.A.
Imperial Institute, Imperial Institute Road, South Kensington, London, S.W.7.
Library of Congress, Serial Record Division, Acquisitions Dept., Washington, 25, D.C., U.S.A.
Linda Hall Library, Science and Technology, 5109, Cherry Street, Kansas City, 4, Missouri, U.S.A.
Liverpool Public Libraries, William Brown Street, Liverpool, Lancs.
Luton Public Libraries, Central Library, George Street, Luton, Beds.
Manchester Public Libraries, Reference Library, Central Library, Manchester, 2, Lancs.
National Library of Scotland, St. Andrews, Fife, Scotland.
National Library of Wales, Aberystwyth, Carm.
New York Public Library, Fifth Avenue and 42nd Street, New York City, 18, N.Y., U.S.A.
Patent Office Library, 25, Southampton Buildings, London, W.C.2.
Science Museum Library, Exhibition Road, South Kensington, London, S.W.7.
Smithsonian Institution, Washington, 25, D.C., U.S.A.
Tottenham Public Libraries, Central Library, High Road, London, N.17.
Trinity College, Library, Dublin, Eire.
Westminster Public Libraries, Central Reference Library, St. Martins Street, London, W.C.2.

Donations

Donations totalling £61 1s. 6d. were received from members during the year and are now gratefully acknowledged.

A list of the donors of amounts of 5s. and over is printed below.

Beadle, R.
Bleach, K. S.
Bolton, A. H.
Bonestell, C.
Burnaby, T. P.
Caplin, S. D.
Clack, J.
Clarke, A. V.
Cleaver, A. V.
Collins, J.
Daniells, D. V.
Dobson, W.
Falkner, H. E.
Fielden, H. E.
Fitzsimmons, R. A.
Hall, D.
Harris, B.
Hewitt, A.
Howell, O. B.
Hunt, C.
Jackson, F. T.
Marler, G. L.
Mulcahy, J.
Murray, F. G.
Page, E. B.
Pinfold, R. F. N.
Powers, W. T.
Reca, J. F.
Renacre, B. J.
Stephenson, F. B.
Strong, J. G.
Trenchard, P.
Wilkinson, R. S.
Woodruff, A. I.

Memorandum of Association

OF

The British Interplanetary Society Limited

1. The Name of the Company (hereinafter called the Society) is "THE BRITISH INTERPLANETARY SOCIETY, LIMITED."

2. The Registered Office of the Society will be situate in England.

3. The Objects for which the Society is established are:—

   (*a*) To succeed and take over such of the property, rights, and obligations of the existing BRITISH INTERPLANETARY SOCIETY and the COMBINED BRITISH ASTRONAUTICAL SOCIETIES as may lawfully be acquired and taken over by the Society.

   (*b*) To investigate all branches of scientific study for the purpose of establishing and maintaining communication between locations on the Earth and positions not on the Earth, and to construct mechanical, electrical, or other devices necessary to facilitate such communication.

   (*c*) To promote, develop, and co-ordinate research in connection with all means of transportation and communication, and to encourage the formation of groups of persons to investigate special problems in any branch of Science conducive to this end.

   (*d*) To encourage the Science of Astronomy and the investigation of stellar regions, and to conduct experiments to increase knowledge of planetary conditions.

   (*e*) To encourage the dissemination of knowledge on scientific matters and to stimulate public interest in interplanetary travel.

   (*f*) To hold Meetings of the Society for reading papers on Science, Transport, and Communication, and the discussion of all subjects relating thereto.

   (*g*) To hold and promote exhibitions of instruments, apparatus, models and other appliances, and drawings, designs, and photographs thereof connected with Science, Transport, and Communication, and the application thereof or upon subjects relating thereto.

   (*h*) To print or cause to be printed, publish, sell, lend, or distribute the Proceedings and Reports of the Society, or any papers, communications, works, or treatises on Science, Transport, and

Communication, or any application thereof, or subjects connected therewith, in English or any foreign tongue, or any abstracts and translations thereof, or extracts therefrom.

(*i*) To borrow or raise money, as the Society may see fit, and to draw, make, accept, endorse, discount, execute, and issue promissory notes, bills of exchange, bills of lading, and other negotiable or transferable instruments.

(*j*) To make grants of money, books, medals, apparatus, or otherwise, for the purpose of promoting invention and research in Science, Transport, and Communication, or the application thereof, or other subjects related thereto.

(*k*) To affiliate with itself British, Colonial, and Foreign societies interested in Science, Transport, and Communication, or other subjects related thereto.

(*l*) To purchase, take on lease, or otherwise acquire, and also to let, lease, or dispose of, any premises or other property for the purposes of the Society.

(*m*) To invest or deal with the moneys of the Society not immediately required in such manner as may be from time to time determined.

(*n*) Subject to the rules of law affecting champerty and maintenance, to raise and administer funds for the purpose of protecting and indemnifying Members of the Society from and against any unfounded claims, and for the purpose of affording its Members legal advice and assistance in connection with their researches and experiments.

(*o*) To consider, originate, and support, improvements in the law which may seem directly or indirectly conducive to the attainment of any of the Society's objects, and to resist and oppose any alterations therein which may seem to the Society, directly or indirectly, adverse to the interests of the Society, or to Members or any section thereof.

(*p*) To enter into any arrangements with any Government or authorities (supreme, municipal, local, or otherwise), or any companies, firms, or persons that may seem conducive to the attainment of the Society's objects or any of them, and to obtain from such Government, authority, company, firm, or person any charters, contracts, decrees, rights, licences, privileges, and concessions which the Society may think desirable, and to carry out, exercise, and comply with any such charters, contracts, decrees, rights, licences, privileges, and concessions.

(*q*) To erect, construct, lay down, enlarge, alter, maintain, pull down, remove, replace, or clear sites for any roads, bridges, reservoirs, stores, buildings, offices, works, fixed plant, machinery, or other real or personal property, necessary or convenient for the attainment of the objects herein set forth; and to contribute to, subsidise,

or join with any person, firm, or company in doing any of the things aforesaid, and to work, manage, and control the same or join with others in so doing.

(*r*) To improve, manage, cultivate, develop, exchange, let on lease, or otherwise mortgage, charge, sell, dispose of, turn to account, grant rights and privileges in respect of, or otherwise deal with any part of the property or rights of the Society.

(*s*) To support or subscribe to any charitable or public object, and any institution, society, or club which may be for the benefit of the Society.

(*t*) To procure the Society to be registered or recognised in any Dominion or Dependency, Colony, or any Foreign Country or Place.

(*u*) To apply for, register, purchase, or by other means acquire and protect, prolong, and renew, whether in the United Kingdom or elsewhere, any patents, patent rights, brevets d'invention, licences, trade marks, designs, protections, and concessions which may appear likely to be advantageous or useful to the Society, and to use and turn to account and to manufacture under or grant licences or privileges in respect of the same, and to expend money in experimenting upon and testing, and in improving or seeking to improve any patents, inventions, or rights which the Society may acquire or propose to acquire.

(*v*) To subscribe for, take, purchase, or otherwise acquire and hold shares or other interests in or securities of any other company, society, or association having objects altogether or in part similar to those of this Society, or carrying on any business capable of being carried on so as directly or indirectly to benefit this Society.

(*w*) To promote any other society, association, or company for the purpose of acquiring the whole or any part of the business and property of the Society or of undertaking any of its liabilities, or of undertaking any operations which may appear likely to assist or benefit this Society, or to enhance the value of any property of this Society, and to place or guarantee the placing of, underwrite, subscribe for, or otherwise acquire all or any part of the shares or securities of any such society, association, or company as aforesaid.

It is hereby expressly declared that each Sub-Clause of this Clause shall be construed independently of the other Sub-Clauses, and that none of the objects mentioned in any Sub-Clause shall be deemed to be subsidiary to the objects mentioned in any other Sub-Clause.

4. The income and property of the Society, whensoever derived, shall be applied solely to the promotion of the objects of the Society as set forth in this

Memorandum of Association, and no portion thereof shall be paid or transferred, directly or indirectly, by way of Dividend, Bonus, or otherwise howsoever, by way of profit to the Members of the Society: Provided that nothing herein shall prevent the payment in good faith of—

(*a*) A reasonable and proper remuneration to any officer, servant, or Member of the Society in return for any services actually rendered to the Society;

(*b*) Interest at a rate not exceeding Five per centum per annum on money lent to the Society;

(*c*) A reasonable and proper rent for premises demised or let by any Member to the Society;

(*d*) Out of pocket expenses incurred by Members on behalf of the Society.

5. The Liability of Members is Limited.

6. Every Member of the Society undertakes to contribute to the assets of the Society in the event of its being wound up while he is a Member, or within one year afterwards, for payment of the debts and liabilities of the Society contracted before he ceases to be a Member, and the costs, charges, and expenses of winding up, and for the adjustment of the rights of the Contributories among themselves, such as may be required not exceeding One Guinea.

Articles of Association

OF

The British Interplanetary Society Limited

Preliminary

1. In these Regulations "The Act" means "The Companies Act, 1929." When any provision of the Act is referred to, the reference is to such provision as modified by any statute for the time being in force.

Members

2. The Subscribers to the Memorandum of Association and such other persons as the Council shall admit to Membership, shall be Members of the Society.

3. The number of Members with which the Society proposes to be registered

is* Eight Hundred, but the Council may from time to time register an increase in the number of Members.

4. Every Member shall be entitled without payment to one Certificate of Membership under the Seal of the Society, which shall be delivered to each Member within two months of his election to Membership.

5. The Society shall consist of the under-mentioned Members:—

(*a*) HONORARY FELLOWS. Election to Honorary Fellowship shall be an honour bestowable by a three quarters majority of the Council.
A Member must be proposed for Honorary Fellowship by at least two other Members.

(*b*) FELLOWS. This shall be open to those Members of the Society who are qualified to assist in research. Members assisting in research or experiments, controlled, supervised, or conducted under the auspices or on behalf of the Society, or sitting on committees governing these matters, must be Fellows. Fellows shall be elected by a majority of the Council, on the application of the Member. Fellows shall pay an annual subscription of Two Guineas.

(*c*) ORDINARY MEMBERS, who shall pay an annual subscription of One Pound.

(*d*) ASSOCIATES, who shall pay an annual subscription of Ten Shillings.†

6. All new Members shall pay an entrance fee of Five Shillings.

7. Subscriptions shall be payable annually, on the first day of January in each year.

8. Any Member being more than six months in arrear with subscriptions shall be deemed as having resigned, without prejudice to any claim by the Society for any amounts due. The Council shall have power at their discretion to reinstate any Member on such terms as they may deem fit.

9. Membership shall be open to any person elected by the Council, and shall entitle the Holder to be present at, and, except in the case of Associates, to vote at all General Meetings and to receive all publications of the Society.

10. At any time after election to the Society, a Member may, subject to the approval of the Council, commute all future annual subscriptions by a payment of a sum unanimously approved by the Council, which shall entitle such Member to all privileges and rights of Membership for the remainder of his life, unless he resigns or his right of membership be rescinded under the provisions of Article 12.

* *This will be amended to read "an indefinite number of Members" on the approval of the Resolution at the Annual General Meeting on 8th December, 1950.*

† *Elections to Associate Membership were discontinued in 1947 and the grade is now in abeyance.*

11. The rights and privileges of Membership shall be personal to the Member, and not transferable or transmissible by his own act or by operation of law.

12. If any Member shall refuse or wilfully neglect to comply with the provisions of the Memorandum or Articles of Association, or Bye-laws laid down by the Council from time to time, or shall be guilty of any conduct likely to be injurious to the Society as the case may be, the right of Membership may be rescinded at any time by the unanimous vote of the Council, who shall call on such member to attend before them or to submit a statement or explanation to the satisfaction of the Council. The Secretary shall, at the direction of the Council, give seven clear days' notice in writing to the Member at his registered address requiring him to attend before the Council or submit such statement referred to above. Any Member may plead before the Council, either on his own behalf or on behalf of any other Member. The decision of the Council is final.

13. The Society shall be managed by a Council of twelve members, or by such other number as the Society in Annual General Meeting may, by ordinary resolution, determine. Not less than three-quarters of the Council shall be Fellows.

14. The first Council shall be appointed within one month of the date of the incorporation by the Eleven Subscribers to the Memorandum of Association, and shall hold office until the first General Meeting of the Society.

15. (*a*) At each subsequent Annual General Meeting following, one-third of the Council for the time being, or, if their number is not a multiple of three, then the number nearest one-third, shall retire from office.

(*b*) The Members of the Council to retire in every year shall be those who have been longest in office since their last election, but as between persons who were elected on the same day, those to retire shall (unless they otherwise agree among themselves), be determined by lot.

(*c*) The Society at the meeting at which a Member of the Council retires in the manner aforesaid may fill the vacated office by electing a person thereto, and in default the retiring Member of the Council shall, if offering himself for re-election, be deemed to have been re-elected, unless at such meeting it is expressly resolved not to fill such vacated office or unless a resolution for the re-election of such person shall have been put to the meeting and lost.

16. No person other than a Member of the Council retiring at the meeting shall be eligible for election to the Council unless, not less than six weeks before the date appointed for the meeting, there shall have been left at the registered office of the Society a notice of nomination in writing signed by a Member qualified to attend and vote at the meeting for which such notice is given, and also notice in writing signed by the person nominated of his willingness to be elected.

17. All acts done by any Meeting of the Council shall, notwithstanding that it be afterwards discovered that there was some defect in the appointment of any person, be valid as if every such person was duly appointed and qualified to act.

18. The Council shall have power at any time, and from time to time, to appoint any person to the Council to fill a casual vacancy, but such person shall hold office only until the next following Annual General Meeting, and shall not be taken into account in determining the Members of the Council who are to retire by rotation at such meeting.

19. The Council may from time to time appoint from among their number and from Members of the Society such Committees and Officers as they deem necessary or expedient, and may depute or refer to them such powers and duties of the Council as the Council may determine.

20. The method of election to the Council shall be prescribed by Bye-law, and shall be by postal ballot, or personally, or by proxy, or by any combination of these methods.

21. A retiring officer of the Council may offer himself for re-election.

22. The Council shall have power from time to time to make, alter and repeal such Bye-laws as they deem necessary or expedient or convenient for the proper conduct and management of the Society. The Council shall adopt such means as they deem sufficient to bring to the notice of Members of the Society all such Bye-laws, amendments and repeals; and all such Bye-laws so long as they shall be in force shall be binding upon the Members of the Society. Provided that no Bye-law shall be inconsistent with anything contained in the Memorandum or Articles of Association, and that any Bye-law may be set aside by a Special Resolution of the Society in General Meeting.

23. The Council may, with the prior consent of a General Meeting, raise or borrow money for the purpose of doing anything which may be conducive to the attainment of the Society's objects, and may secure the repayment of any sums aforesaid by mortgage or charge upon the whole or any part of the property or assets of the Society, present and future.

24. If any of the Council or other person become personally liable for the payment of any sum primarily due from the Society, the Council may, subject to the provisions of Section 152* of the Act, indemnify such person becoming liable as aforesaid from any loss in respect of such liability.

25.
26.
27.
28.
29.

These articles were cancelled by Special Resolution of the Society dated 17th December, 1948.

Branches

30. Any seven Members in one place may, subject to the sanction of the

* *Now Section 205 of the Companies Act, 1948.*

Council, form a Branch, and elect a Branch Chairman to act within the limits imposed by the Council.

Meetings

31. An Annual General Meeting shall be held once in every calendar year, at such time (not being more than fifteen months after the holding of the last preceding Annual General Meeting) and place as may be prescribed by the Council, to receive the reports of the Council and Auditors, and for the election of Auditors and Officers of the Council in place of those retiring. In default of a General Meeting being so held a General Meeting shall be held in the month next following, and may be convened by any two Members, in the same manner as nearly as possible as that in which the Meetings are to be convened by the Council.

32. The Council may, whenever they think fit, convene an Extraordinary General Meeting, and Extraordinary General Meetings shall also be convened on such requisitions, or in default by such requisitions as provided by Section 114* of the Act.

33. Notice of General Meetings shall be given to all Members in Great Britain (subject to the provisions of Section 117 (2)† of the Act, relating to special resolutions) at least twenty-one clear days before the Meeting, and shall specify the date, hour, and place, and the general nature of the business to be transacted.

34. The Chairman may, with the consent of any Meeting at which a quorum is present (and shall if so directed by the Meeting), adjourn the Meeting from time to time and/or place to place, but no business shall be transacted at any adjourned Meeting other than the business left unfinished at the Meeting from which the adjournment took place. When a Meeting is adjourned for ten days or more, notice of the adjourned Meeting shall be given as in the case of an original Meeting. Save as aforesaid, it shall not be necessary to give any notice of an adjournment or of the business to be transacted at an adjourned Meeting.

35. A notice may be served by the Society upon any Member either personally or by sending it through the post, addressed to such Member at his registered address.

36. No Member shall be entitled to have a notice served on him at any address not within the United Kingdom.

37. Any notice if sent by post shall be deemed to have been served at the expiration of twenty-four hours after the same shall have been properly addressed, stamped, and put into a post office or post box subject to the control of the Postmaster-General.

38. The accidental omission to give notice of a Meeting to, or the non-receipt of a notice by, any Member shall not invalidate the proceedings of the Meeting.

* *Now Section 132 of the Companies Act, 1948.*
† *Now Section 141 of the Companies Act, 1948.*

39. Subject to these Articles, the Meeting may elect its own Chairman.

40. No business shall be transacted unless a quorum is present. The number of Members required to be a quorum is as under:—

(*a*) Quorum for Extraordinary and Annual General Meetings is five.

(*b*) Quorum for a Council Meeting is three.

(*c*) Quorum for a Committee Meeting is three.

41. If a quorum is not present within half an hour of the time appointed for the commencement of the Meeting, the Meeting is dissolved.

42. Each Member shall be at liberty to introduce visitors at General Meetings, subject to the permission of the Chairman of the Meeting.

43. Any Member may vote for or against a motion by proxy, and a signed statement on his behalf shall be produced by any other Member who shall vote on behalf of such Member. The instrument of proxy shall be in writing in the common form or such other form as may be approved by the Council. Proxies shall not be counted for the purpose of forming a quorum.

Voting

44. Every Member, with the exception of Associates, shall have one vote, whether on a show of hands or by poll. In the case of an equality of votes, the Chairman shall have a second or casting vote.

45. Any two Members personally present, excluding Associates, may join to demand a poll, such poll to be taken as decided by the Chairman of the Meeting.

46. On a poll votes may be given, either personally or by proxy. A proxy must be a Member of the Society.

47. The instrument appointing a proxy shall be deemed to confer authority to demand or join in demanding a poll.

48. The proceedings at General Meetings, in so far as they are not inconsistent with these Articles, shall lie in the hands of the Chairman.

49. The instrument appointing a proxy must be deposited at the Registered Office of the Society not less than forty-eight hours before the time of holding the Meeting or adjourned Meeting at which the person named in the instrument proposes to vote, and in default the instrument of proxy shall not be treated as valid.

Minutes

50. The Council shall cause Minutes to be made in books provided for the purpose—

(*a*) Of all appointments of officers;

(*b*) Of the names of persons present at each Meeting;

(*c*) Of all resolutions and proceedings at all Meetings of the Society.

And every person present at any Meeting shall sign his name in a book kept for that purpose.

Accounts and Audit

51. The Council shall cause proper books of accounts to be kept with respect to:—

(*a*) All sums of money received and expended by the Society, and the matters in respect of which such receipt and expenditure takes place.

(*b*) All assets and liabilities of the Society.

(*c*) The books and accounts shall be kept at the Registered Office of the Society, or such other place as the Council may decide.

(*d*) The Council shall lay before the Members in Annual General Meeting an Income and Expenditure Account, and Annual Balance Sheet.

52. Auditors shall be appointed by the Society in General Meeting, and their duties shall be regulated in accordance with Sections 132, 133, and 134* of the Act.

Seal

53. The Seal of the Society shall not be affixed to any instrument except by authority of a resolution of the Council, and in the presence of the Secretary and one other Member of the Council, who shall sign every instrument to which the Seal is affixed in their presence.

Winding Up

54. In the event of the Society being wound up, any assets in its possession shall be distributed equally among the Members.

* *Now Sections 159, 160, 161 and 162 of the Companies Act, 1948.*

No. 402,498

Certificate of Incorporation

I Hereby Certify that THE BRITISH INTERPLANETARY SOCIETY LIMITED is this day Incorporated under The Companies Act, 1929, and that the Company is **Limited.**

Given under my hand at London this Thirty-first day of December, One Thousand Nine Hundred and Forty-five.

P. MARTIN, *Registrar of Companies.*

Bye Laws

OF

The British Interplanetary Society Limited

Preliminary

1. These Bye-Laws shall operate on and from the 1st day of January, 1951, except insofar as they may subsequently be amended, cancelled, or added to by Resolution of the Council, in which case they shall operate from the date when notice is given to Members.

2. The financial year of the Society shall commence on and from the first day of October in each year.

3. The forms set forth in the Schedule to these Bye-Laws shall be used in the cases to which they are applicable, with such alterations, if any, as the Council may from time to time determine; and all notes and directions thereon shall be deemed part of the forms and observed accordingly.

Membership

4. Every application for admission to Membership shall be made on a form supplied by the Society in the Form "A" set out in the schedule hereto, and every applicant shall satisfy the Council in such manner as the Council shall require that he has fulfilled the conditions specified, and shall produce such evidence of his fitness to be admitted or elected as the Council shall deem necessary.

5. The Council, in their absolute discretion, by resolution passed at a duly convened meeting, may refuse to admit or elect any person to any class of Membership, and it shall not be necessary for the Council to give any reasons for their refusal.

6. No applicant shall be eligible for admission as a Fellow unless he possesses at least one of the following qualifications:—

(*a*) A degree from a recognised University in Science, Mathematics, Engineering, or Medicine.

(*b*) Corporate Membership or Graduateship of a Technical Institution recognised by the Council for this purpose.
The following Institutions are recognised by the Council for this purpose:—

Institute of Physics.
Institution of Civil Engineers;
Institution of Electrical Engineers;
Institution of Mechanical Engineers;
Royal Aeronautical Society;
Royal Institute of Chemistry

Consideration will be given to other Institutions of a generally comparable status.

(*c*) Higher National Certificate, or an equivalent.

(*d*) An examination qualification equivalent to National Certificate or Intermediate B.Sc., plus five years' relevant scientific or industrial experience.

(*e*) A large body of relevant scientific or industrial experience.

(*f*) Submission of a thesis on a relevant subject, which satisfies the Council as to the eligibility of the applicant.

(*g*) Considerable contributions to the development of astronautics.

The decision of the Council as to the eligibility of any applicant in regard to the relevance of his industrial or scientific experience or examination qualifications shall be final.

7. Every person shall, upon applying for admission, sign an undertaking that he will, if admitted, and for so long as he is a Member, observe all the provisions of the Society's Memorandum and Articles of Association and Bye-Laws for the time being in force.

8. Every Member shall be entitled to a Certificate of Membership (or Fellowship) in the form "B" set out in the Schedule hereto, signed by the Chairman and Secretary of the Society, and given under the seal of the Society, but such Certificate shall remain the property of the Society.

9. No Member whose subscription remains unpaid after 31st March in any year shall be entitled to receive copies of publications or notices of meetings, or be entitled to attend and vote at any meeting of the Society.

Subscriptions

10. Annual subscriptions are payable on the 1st day of January in each year, but persons making application to join after 30th June in any year may pay one half-years' annual subscription, unless they wish to receive copies of all the publications issued in that year, in which case a full years' subscription shall be payable.

11. In accordance with the provisions of Article 10, annual subscriptions may be compounded at the following scale:

Age limits	Membership	Fellowship
	£	£
20-25	25	35
26-30	23	32
31-35	21	30
36-40	18	26
41-50	16	22
51-	14	18

12. The Council may from time to time and on such grounds considered in their opinion to be adequate, make such provision as they deem expedient for the sale or free distribution of the Society's publications to non-members, and for the fixing of prices and subscription rates therefor.

Resignations and Readmissions

13. In the event of the resignation, lapse arising from non-payment of subscription, rescission of Membership under the provisions of Article 12, or cessation of Membership arising from any other cause, the Certificate of Membership (or Fellowship) shall be delivered up to the Society. Any Member whose Membership ceases in the manner specified herein shall not be entitled to the return of any monies paid by him by way of subscription, entrance fee, or voluntary contribution.

14. A Member may resign at any time by sending his written notice of resignation to the Council, and on its acceptance by the Council, he shall cease to be a Member, but the Council may, at any future time, readmit him to Membership, or they may refuse to readmit such Member without assigning any reason for such refusal.

15. Subject to Bye-Law 16, a readmission fee of 5/- shall be payable where application is made to reapply for Membership after the expiration of six months from the date when the last annual subscription paid by such applicant expired.

16. Any such applicant for re-admission may elect to pay the annual subscriptions corresponding to the grade in which he is seeking re-election for the years from the date when his last annual subscription expired to the year of re-admission, in which case he shall be entitled to receive copies of such of the publications issued in the intervening years which may still be available, and no readmission fee of 5/- shall be payable.

Honorary Fellows

17. Honorary Fellows shall be entitled to all the privileges of Membership, including the right to vote at general meetings of the Society and to be elected and serve on the Council.

18. The number of Honorary Fellows shall be restricted to ten.

Election to the Council—Postal Ballot

19. Where the number of candidates nominated exceeds the number of vacancies required to be filled, election to the Council shall be conducted by voting papers as herein provided.

20. The Secretary shall, not less than three weeks before the date of the Annual General Meeting, send a voting paper to each Member.

21. The voting papers shall be delivered or returned by post to the Secretary at the Registered Office of the Society at least two clear days before the day fixed for the Annual General Meeting, and no account shall be taken of any papers received later.

22. No election shall be in any way invalidated by virtue only of the fact that any member shall have been unable to vote on account of the date on which his voting paper was received by him.

23. The Chairman shall, from among the Members of the Society other than the Candidates, appoint two scrutineers, and the Secretary shall deliver the voting papers unopened to the Scrutineers, by whom alone they shall be opened and examined.

24. (1) The Scrutineers shall place a report before the Chairman at the Annual General Meeting stating:—

(*a*) The total number of voting papers received.

(*b*) The total number rejected and the general grounds for rejection.

(*c*) The total number of votes in favour of each candidate and the names of those duly elected.

(2) The report of the Scrutineers shall be conclusive. Provided that in the event of an equality of votes, the meeting shall be given a casting vote by show of hands to complete the election.

Chairman

25. The first business to be decided by the Council at its first meeting following the Annual General Meeting shall be the election from among its number of a Chairman of the Society for the ensuing year. This election shall be by postal ballot, and the Secretary shall request nominations from each member of the new Council not less than one week before the date fixed for the aforesaid meeting. The person receiving most nominations in this way shall be elected, provided he is willing to serve, or if he is not, the one who is willing to serve with the greatest number of nominations shall be elected.

26. The Chairman so elected shall take the Chair at all meetings of the Society, its Council and Committees, at which he is present, except those for which the Bye-Laws in force direct otherwise.

27. The Council may appoint a Vice-Chairman to act in the absence of the Chairman. In the absence of the Chairman, Vice-Chairman, or other person required by these Bye-Laws to take the Chair at meetings, the meeting may proceed to elect its own Chairman.

28. The term of office of the Chairman (and any Vice-Chairman) of the Council shall be for one year, but he shall be eligible for re-election if still a Member of the Council in the succeeding year, provided that he shall not serve in this office for more than three consecutive years.

Committees

29. The Chairman of the Society shall be an ex-officio Member of all Committees.

30. The Council shall have power to fill any casual vacancies on Committees, and to suspend or remove any Member thereof.

31. All Committees shall perform such duties as may be vested in or assigned to them by the Council from time to time, and all matters dealt with shall be reported to the Council, with whom final authority in all matters shall remain.

32. The Council, at their first meeting after the Annual General Meeting, shall proceed to the appointment of the following Standing Committees:—

(*a*) *Finance and General Purposes.* To deal with all matters relating to the accounts and financial affairs of the Society, the sanctioning of items of expenditure and the drawing and signing of cheques therefor, receipt of monies by way of entrance fees, subscriptions, etc., the investment of the funds of the Society, and any other duties delegated to it by the Council for the conduct of the general business of the Society.

(*b*) *Library Committee.* To deal with the establishment and maintenance of the Society's library.

(*c*) *Publications Committee.* To deal with all matters relating to the Journal, Annual Report and List of Members, Book List, Brochures and any other publications authorised by the Council.

(*d*) *Technical Advisory Committee.* To deal with all matters of a technical nature affecting the fulfilment of the Society's objects. The Technical Director, or his deputy, shall take the chair at any meeting of this Committee.

Branches

33. Subject to the provisions of Article 30, where, in the opinion of the Council, the Members residing in one area are of sufficient number to warrant the formation of a Branch, the Council may take such steps as they consider necessary to form a Branch in that area.

34. On formation, and at all times during their existence, Branches shall conduct their affairs in such manner as laid down by the Council, and in particular, keep proper accounts of income and expenditure and submit reports of Branch activities to the Council at such frequency as the Council may decide.

35. The Council shall have power to dissolve a Branch for any of the following reasons:—

(*a*) Non-compliance with the requirements laid down by the Council.

(*b*) If the number of the Branch membership or the effective support given to Branch activities is, in the opinion of the Council, inadequate to justify its continued existence.

(*c*) Where for any other reason the Council deems it in the interests of the Society that the Branch shall be dissolved.

36. All expenses of each Branch shall be borne by the members of that Branch, but the Council may make grants from the general funds of the Society towards the expenses or cost of formation of Branches, of such amounts as are in their opinion reasonable, having regard to the activities and membership of the Branch and the effect on the attainment of the Society's objects.

Representatives

37. The Council may, from time to time, appoint representatives from among the Members of the Society for any district within Great Britain, or for any part of the British Commonwealth or Colonies, or Foreign countries, with such powers and duties and for such period as the Council may determine.

38. The Council shall have power to remove or suspend any representative.

39. A representative shall, *ipso facto*, vacate office on the formation of a duly constituted Branch for the district for which he was appointed, or on the fulfilment of some other specific purpose for which he was appointed, or if he ceases to be a Member of the Society.

Secretary

40. The Secretary of the Society shall be appointed by the Council upon such terms and subject to such conditions as the Council shall determine, subject to the Memorandum and Articles of Association, and for such purposes the Council may enter into an agreement containing these terms, which shall be sealed with the seal of the Society.

The principal duties of the Secretary shall be:—

(*a*) To answer all correspondence and enquiries.

(*b*) To receive applications for membership.

(*c*) To collect and account for all monies received.

(*d*) To keep proper accounts of income and expenditure.

(*e*) To keep the Library in accordance with the policy laid down by the Library Committee.

(*f*) To give notice of all meetings and to prepare agenda, minutes, etc.

(*g*) To deliver all necessary documents required by law for registration with the Registrar of Companies.

(*h*) To countersign all cheques and generally to act on the instructions of the Council from time to time not unlawful or contrary to the Companies Act, 1948, or inconsistent with the Society's Memorandum or Articles of Association or these Bye-Laws.

Form A. $\frac{M}{F}$ *No.*.....

The British Interplanetary Society

LIMITED (BY GUARANTEE)

Secretarial Address:—157, FRIARY ROAD, LONDON, S.E.15

APPLICATION FOR ADMISSION TO MEMBERSHIP

Surname..... Christian Names.....
(IN BLOCK LETTERS) (IN FULL)

Permanent Address.....

.....

.....

Tel. No..... Date of Birth..... Nationality.....

Degrees and Certificates held.....

.....

.....

Names of other Societies with which you are connected:

NAME..... MEMBERSHIP GRADE.....

" ..... " " .....

" ..... " " .....

" ..... " " .....

Present Occupation.....

Name and Address of Employers.....

.....

Proposed by..... Class..... Number.....
(IF INTRODUCED BY ANOTHER MEMBER)

[P.T.O.

Particulars of Specialised Knowledge, Experience or other qualifications:—

.....

.....

.....

.....

.....

.....

.....

To The Council,
British Interplanetary Society.

Gentlemen,

I wish to apply for admission to membership as $\frac{\text{Fellow}}{\text{Member}}$ of the Society and accordingly enclose herewith £ : s. d. for Entrance Fee and Annual Subscription to 31st December, 195....

I hereby undertake, if admitted, that so long as I remain a member of the Society I will observe all the provisions of the Memorandum and Articles of Association, and Bye-Laws of the Society for the time being in force.

Signature..... Date.....

FOR OFFICIAL USE ONLY

Rcvd. ..... Entrance Fee.....

Submt. ..... Ann. Sub. to 195.....

Class:—Fellow/Member Receipt No. .....

Annual Subscription:—MEMBERS £1 : 0 : 0; FELLOWS £2 : 2 : 0;
Entrance Fee 5/-

The British Interplanetary Society

Founded 1933

(Limited by Guarantee)

Incorporated 1945

This is to Certify that

was admitted to Membership of the Society

this _____ day of _____ 195____

The Society's Seal is impressed here

Given under the Common Seal of the Society

_____ CHAIRMAN OF THE COUNCIL

_____ SECRETARY

Membership Number _____

INDEX

JOURNAL OF THE BRITISH INTERPLANETARY SOCIETY
VOLUME NINE

A

A.4 (*see* V.2)
A.9/A.10 project, 58, 155
Abstracts, 45, 79, 144, 199, 248, 290
Acceleration, physiological effects, 17, 36
Aerobee rocket, 53
Aerodynamics, 209
Albedo, of Pluto, 281
Alcohol, propellant calculations, 287
American Rocket Society, 51, 280
Anglo-Australian long range weapon project, 1, 56, 197
Anti-gravity, 221, 303
"Aphrodite Project," 211
Astronautics
  initial objectives, 155
  surveyed, 209, 253, 297
Astrophysics, from artificial satellite, 140
Atlantic rocket range, 283
Atmosphere
  heating by friction in, 261
  of Moon, 23
  for spacesuit, 30
Atomic
  Physics, film, 104
  rocket,
    circum-lunar, design, 165, 169
    take-off mass, 9
Australian rocket range, 1, 56, 197
Aviation medicine, 296

B

B.B.C. television talks, 192, 279
Bacteria, 62, 254, 302
BEMAC Computer, 187
Beta rocket, 282
BIOGRAPHIES
  Esnault-Pelterie, R., 38, 39
  Oberth, H., 87, 139
  Pirquet, G. von, 205
  Sänger, E., 58
  von Braun, W., 57
Boots, for lunar use, 27
Boron hydride, as propellant, 187
"Bouncing Putty," 56
BRITISH INTERPLANETARY SOCIETY
  accounts, 1950, 313, 326
  A.G.M.
    1949, 37
    1950, 305
  Articles of Association, 368
  Book List, 139
  Bye Laws, 375
  Chairman's Address, 310
  Christmas cards, 245
  constitution, 365
  conversazione photographs, 194
  Council, 37, 191, 314
  delegates to Paris conference, 316
  donations, 364
BRITISH INTERPLANETARY SOCIETY—contd.
  essay competition results, 267
  film shows, 64, 103
  Finance and General Purposes Committee, 313
  history, 49, 93
  Honorary Fellows, 39, 57, 58
  lecture notes, 139
  Library
    announcements, 191, 285, 312
    Committee, 312
    donations, 74, 198
  meetings, 47, 91, 150, 259, 306, 308, 311
  members, list of, 328
  Memorandum of Association, 365
  North-Western Branch
    film show and exhibition, 247
    lectures, 308
  Publications Committee, 311
  publications, public libraries holding, 364
  spaceship, pre-war, 97
  Technical Advisory Committee, 312
  visits, to Hampstead Observatory, 282
Butane, propellant calculations, 287

C

Carbon Dioxide, removal from atmosphere, 33
Centrifuges, new, 141
Characteristic velocity
  for Earth/Mars journey, 77, 238
  take-off mass and, 4, 12
Ciolkowsky, K. E., 257
Circum-lunar rocket, 163
Cochlea, 19
Coelostat, 100
Colonisation of Planets, 105
Commensals, living organisms, 62
Computers
  BEMAC, 187
  Douglas automatic analyser, 189
Cooling
  film, 129
  of rocket motor, 121
CORRESPONDENCE
  Antigravity,
    B. M. Adkins, 303
  Aphrodite Project, The,
    "P. Latham," 211
  Lunar Spacesuit,
    C. A. Cross, 258
    H. E. Ross, 300
  Perturbations of a Satellite Orbit,
    E. Burgess, 255
  Potentially Pathogenic Organisms on Another Planet,
    J. Harper, 254
    E. R. Nye, 302

CORRESPONDENCE—contd.
Prof. Hermann Oberth—A Reply to Otto Hester, W. von Braun, 87
Protection Against Meteors, H. E. Ross, 90
Symposium on Medical Problems, A. E. Slater, 89; R. G. White, 89
Two Russian Rocket Pioneers, E. Bialoborski, 257
Cosmic dust, and interstellar travel, 154
Culture media, as spaceship equipment, 63, 254

D

Deceleration experiments, 187
Delegates to Paris Conference, 316
Destination Moon, film, 139, 241, 284, 285
Diborane, as propellant, 187
Douglas analyser, 189
Dust, interstellar, effects on rocket, 154

E

Ear, inner, balancing mechanism, 18, 89
Earth
horizon distance, 30
oblateness, perturbation of satellite by, 134, 256
population trends, 105, 194
satellite vehicle, 55, 140, 158
Earth/Moon/Earth trip, take-off mass, 7
Effects of Interplanetary Flight, discussion, 105
Efficiency
impulse-, 112
of rocket motor, 109, 111
Efflux, Gone with the, 93
Ehrenbuch der Astronautik, 138
Electromagnetic launching, 261
Electropult, 264
Errata, 74
Essays, 268, 271, 273
Ether, propellant calculations, 287
Ethyl alcohol, propellant calculations, 287
Expendable-tank step-rockets, 159, 164

F

Fairchild Lark, guided missile, 188
Feurlillie rocket, 56
Film cooling, 129
FILM REVIEWS
Destination Moon, 241
Faster than Sound, 104
German A4 Rocket, 103
History of Rocket Development, 64
Rocketship X–M, 245
Firebird, guided missile, 189
Flames, in absence of gravity, 71
Flow measurements, rocket propellants, 118
Flying Saucers, 142, 195, 196, 284, 299
"Frau im Mond," film, 66, 241
Fuels, performance calculations, 286

G

GAPA rocket, 187
General Electric telemetering system, 56
Gesellschaft für Weltraumforschung (Stuttgart), annual report, 137
Gone with the Efflux, 93
Gravity
absence of, effect on ear, 21
ear, effect on, 19
flames and, 71
fuel consumption in absence of, 184
physiological stress and, 16
Griffith Observatory, planetarium, 281
Guided missiles, 56, 71, 188, 189, 207

H

Hayden Planetarium, and Astronautics, 279
Heat transfer
in rocket motor, 109, 121
spacesuit, 25, 34
Heinkel, Prof., and astronautics, 138
Helium, in spacesuit air supply, 31
Helmet, spacesuit, 27
Hermann Oberth Medal, 137
History of Rocket Development, film, 64
Horizon distance, 30
Humidity, in spacesuit, 33
Hydrogen peroxide
rocket applications, 208
for spacesuit air supply, 31
Hypersonic airflow, 140

I

Ignition, rocket motor, 112
Impulse
efficiency, 112
specific, 111, 112, 116
Initial objectives in astronautics, 155
Instruments
protection from shock, 56
for rocket cooling tests, 129
Insulation, spacesuit, 25
International conference on astronautics, 137, 191, 313, 315
Interplanetary travel
books, 253, 297
effects, 105
supernatural, 214
Interstellar rockets, and meteors, 154
Ionosphere, 211

K

Kibalczyc, N. I., 257
Kummersdorf proving grounds, 57

L

Landing, of spaceship, 279
Lark, guided missile, 188
Launching
electromagnetic, 261
site, Australian, 1
Ley, Willy, 50, 65

Living organisms, on other planets, 17, 62, 90, 254
Loading diagrams, circumlunar rocket, 169, 170, 173
Logarithmic spiral, as trajectory, 76, 232
Lunar (*see* Moon)
Lunar spacesuit, 23, 258, 300

M

Macula, 20
Mars
  bacteria on, 62
  cloud on, 142, 280
  described, 298
  drawings, 208
  voyage to, 77, 237
Mass, take-off-, calculation of, 5
Mass ratio, minimising, 180
Matters of No Moment, 49
Medal, Hermann Oberth, 137
Medical problems of spaceflight, 14
Medicine, aviation, 296
Meetings, recent and forthcoming, 47, 91, 150, 259
Meteors
  protection against, 90
  and space travel, 153
Minimal trajectories, 179
Miranda, satellite of Uranus, 192
Models, 246
Moon
  bacteria on, 62
  conditions on, 23
  circular velocity, 262
  electromagnetic launcher on, 262
  escape velocity, 262
  horizon distance, 30
  perturbation of spacestation by, 132
  radio on, 30
  spacesuit for, 23
  surface features, 210
  temperature, 25, 30
  voyage to, 13
Motor, rocket, testing, 108

N

Nebel, R., 50, 68
Nereid, satellite of Neptune, 192
Notes and News, 70, 137, 191, 279

O

Oberth, Medal, 137
OBITUARY
  Stapledon, Olaf, 285
Objectives, initial, in astronautics, 155
Orbit (*see also* Trajectories)
  satellite, perturbations, 131, 255
Orbital
  refuelling, 12
  rocket, 55, 158
Organisms, pathogenic, on other plants, 62, 254, 302
Otoliths, 20
Oxygen supply, spacesuit, 28, 30, 259, 301

P

Parachute, for A10, 156
Paris Conference, 137, 191, 313, 315
Pathogenic organisms, 62, 254, 302
Payload ratio, 5
Peenemunde, work at, 57, 87
Performance calculations, rocket propellants, 286
Perturbation, of satellite orbit, 131, 255
Petrol, propellant calculations, 287
Physiological strain, 16
Planets, colonisation, 105
Pluto, new measurements, 280
Power
  electromagnetic launcher, 262
  rocket motor, 110
Powered rocket, trajectory in space, 75, 230
Project RAND, 55, 140, 158
Propane, propellant calculations, 287
Propellants
  choice of, 116
  ideal exhaust velocity, 139
  new, tested, 187
  performance calculations, 286
Protuberances, solar, film, 103
Proving grounds
  Kummersdorf, 57
  Peenemunde, 56, 57, 87
  Tor Cloud, 50
  Trauen, 60
  Woomera, 1, 56, 197
Psychological problems of space flight, 14
Pumping problems, step-rocket, 176

R

R.E.P.-Hirsch prize, 40
Radiation (*see* Heat Transfer)
Radio
  approach device, 279
  communication on Moon, 30
  short wave, 211
Raketenflugplatz, V.f.R., 68
RAND project, 55, 140, 158
Reactor, atomic, 165
Reaction Motors, Inc., history, 71
Refuelling, spacestation, 12, 256
Relativity, extension to theory, 195
Research Scene, 53, 187
Respiration, table, 32
REVIEWS, BOOK
  Achievements of Modern Science (Merriman), 252
  Atmospheres of the Earth and Planets, The (Kuiper), 43
  Aviation Medicine in its Preventive Aspects: An Historical Survey (Fulton), 296
  Conquest of Space, The (Ley and Bonestell), 41
  Face of the Moon, The (Baldwin), 210
  Flying Saucers are Real, The (Keyhoe), 299
  Guided Missiles (Weyl), 207

Reviews, Book—contd.
Interplanetary Flight: An Introduction to Astronautics (Clarke), 253
Kleine Raketenkunde (Kaiser), 206
Konstantin Eduardovich Ziolkovsky (Kosmodem'yanskii), 42
L'Astronautique (Ananoff), 297
L'Astronautique (Laming), 209
Our Sun (Menzel), 86
Planet Mars, The (de Vaucouleurs), 298
Raketen von Stern zu Stern (Gartmann), 207
Rocket Propulsion Elements (Sutton), 44
Rockets and Jets (Way and Green), 85
Science of Flight, The (Sutton), 209
Short-Wave Radio and the Ionosphere (Bennington), 211
Telescopic Observations of Mars (Webb), 208
Thermodynamic Charts for Combustion Processes (Hotell, Williams and Satterfield), 151
Weltraumfahrt: Utopie?, 85
Weltraumflug (Schaub), 207
Rocket
A.4 (*see* V.2)
A.9/A.10, 58, 155
Aerobee, 53
aircraft, 69, 142, 157
Beta, 282
circum-lunar, 163
development, history of, film, 64
Feurlillie, 56
in fiction, 223
Firebird, 189
GAPA, 187
Gloria, 65
HW.2, 65
history, 64, 252
Lark, 188
Mirak, 68
motor
cooling, 121
efficiency, 110
heat transfer, 109, 121
ignition, 112
impulse, 109
impulse efficiency, 112
nozzle, 114
power, 110
specific impulse, 111, 116
temperature, measurement, 109, 114
testing, 108
throughput, measurement, 118
thrust, calculation, 275
thrust, measurement, 118
wall temperature, 124
orbital, 55, 158
posts, 66, 284
propellants, 116, 187, 286
ranges
Anglo-Australian, 1, 56
Atlantic, 283
Repulsor, 68
Rocket—contd.
societies, 324
Soviet, 56
Sprite, 282, 305
step-, 54, 55, 58, 156, 157, 283
thrust, calculating, 275
Tiling, 66
V.2, 53, 57, 88, 102, 103, 208, 246, 261
V.2/WAC Corporal, 54, 55
Viking, 53, 55
WAC Corporal, 54, 55
Zeus, 53
"Rocket-ship X-M," film, 245, 285
Russian
pioneers, 257
rocket research, 56, 283
Ryan Firebrand, guided missile, 189

S

S.B.A.C. display, 1950, 282
Saccule, 20
Satellites, artificial
astrophysics from, 140
orbit perturbations, 131, 256
RAND, 55, 158
Science fiction, 213
Semicircular canals, 19
Societies, rocket, 324
Solar
eclipse, film, 103
protuberances, film, 103
Soviet rockets, 56
Spaceguns, 219
Spaceflight
medical problems, 14, 18, 23
psychological problems, 14
"Spaceship I Departs," film, 64, 67
Spaceship
B.I.S. pre-war cellular-, 90, 97, 101
landing, 279
Spacestation
astronomy and, 73
astrophysics and, 140
in fiction, 228
refuelling, 12
Spacesuit, lunar, 23, 36, 258, 300
Space-Travel
effects of, 105
in fact and fiction, 213
meteors and, 153
problems discussed, 252
projectors, 281
Specific impulse, 111, 116
Spiral, logarithmic, as trajectory, 76, 232
Sprite, rocket, 282, 305
Structural factor, 5
Sun, perturbations of Earth satellite by, 132, 256

T

Take-off mass, calculation of, 5
Tanks expendable, 169, 172, 174
Telemetering, 56

Telescopes in space, 141
Temperature
  Moon, 25, 36
  rocket motor, 121
  spacesuit, 34
Thermodynamics, of rocket motor, 109
Thrust
  calculation, 275
  measurement, 118
Trajectories (*see also* Orbits)
  minimal, 179
  powered rocket in space, 75, 230
  space rocket, 235
Transfer orbits, 230

U

Uranium fission, film, 104
Uranus, new satellite, 192
Utricle, 20

V

V.2 rocket
  development, 57, 88, 208
  film, 103
  heating by air friction, 261
  launching preparation, 102
V.2 rocket—contd.
  model, 246
  U.S. program ends, 53
V.2/WAC Corporal, 54, 55
Vacuum insulation, spacesuit, 27
Velocity
  change, Earth/Mars trip, 77
  characteristic, 4, 12, 238
  circular, Moon, 262
  escape, Moon, 262
Venturi effects, 114, 116
Venus
  bacteria on, 62
  conditions on, 70
  voyage, 237
Viking rocket, 53, 55

W

WAC Corporal, rocket, 54, 55
Weltraumfahrt, 138
"Weltramschiff I Startet," film, 64, 76
Woomera, 2, 56

Z

Zeus, rocket, 53
Zwicky, F., awarded medal, 71

AUTHOR INDEX

Carter, L. J. Anglo-Australian Long Range Weapon Project, 1
Cashmore, D. J. Why Space Travel Interests Me, 268
Clarke, A. C.
  Space-Travel in Fact and Fiction, 213
  Electromagnetic Launching as a Major Contribution to Space-Flight, 261
Cleator, P. E. Matters of No Moment, 49
Cleaver, A. V.
  The Calculation of Take-Off Mass, 5
  A Review of "Destination Moon," 241
  Report on First International Astronautical Congress, Paris, 1950, 315
Dixon, A. E. *See* Gatland, K. W.
Forbes, G. F. The Trajectory of a Powered Rocket in Space, 75
Gatland, K. W.
  The Research Scene, 1V–V, 53, 187
  History of Rocket Development: Film Review, 64
———, Dixon, A. E., and Kunesch, A. M. Initial Objectives in Astronautics, 155
Gerard, V. B. Why Interplanetary Travel Interests Me, 273
Gillings, W. H. Report of the Discussion on the Effects of Interplanetary Flight, 105
Herrick, S. Space Rocket Trajectories, 235
Kunesch, A. M. *See* Gatland, K. W.
Lawden, D. F.
  Minimal Trajectories, 179
  Note on a Paper by G. F. Forbes, 231
Neat, W. N. Review of the Society's Film Show, 103
Nebbia, G. Performance Calculations of Some Fuels for Rocket Motors, 286
Nye, E. R. The Possibility of Potentially Pathogenic Organisms Occurring on Another Planet, 62
Oberth, H. Three Equations for Rapid Calculation of Rocket Motor Thrust, 275
Patchett, Mrs. M. E. What the B.I.S. should do to hasten the Conquest of Space, 271
Pirquet, G. von. Meteors and Space-Travel, 153
Ross, H. E. Gone with the Efflux, 93
——— and Smith, R. A. Lunar Spacesuit, 23
Slater, A. E. The Balancing Mechanism of the Inner Ear, 18
Slater, E. T. O. Psychological Problems of Space-Flight, 14
Smith, R. A. *See* Ross, H. E.
Spitzer, L., Jnr. Perturbations of a Satellite Orbit, 131
Zumpe, H. F. The Testing of Rocket Motors, 108.

ABSTRACTS

SUBJECT INDEX

The number in brackets following the page reference indicates the number of the abstract on that page. A "P" following the reference indicates a patent.

A

A.4 (*see* V.2)
Accelerometer, Missile, 250 (i)
Aerobee, 148 (5), 148 (8)
Aircraft (*see also* Assisted take-off)
  Douglas Skyrocket, 149 (1), 149 (4)
  Nuclear energy for, 147 (8)
  Pilotless, 83 (4)
    instrumentation, 203 (9)
  Rocket-propelled, 148 (16), 148 (17), 148 (18), 149 (3), 203 (4), 203 (7)
    first, 291 (1)
    range, 148 (20)
Aluminium Borohydride
    Physical properties, 251 (11)
    as a Propellant, 251 (6)
Assisted take-off
  (*see also under* De Havilland "Sprite"; Rocket motor)
  Navion, 148 (19), 149 (2)
Astronautics (*see* Spaceflight)
Atmosphere
  Cloud observations
    from rockets, 146 (6)
  General, 147 (1), 248 (7), 248 (8)
  on Moon, inquiry into, 248 (1)
  Upper, *see also* Aerobee
    cosmic-ray, intensity, 296 (1), 296 (2)
    general, 199 (7), 199 (9), 248 (5)
    instrumentation of V.2 for research, 146 (5)
    magnetic field at White Sands, 248 (6)
    ionosphere, 146 (8), 296 (3)
    radiation measurement, 199 (10)
    stratosphere, composition, 199 (8), 295 (10)
    temperature distribution over New Mexico, 248 (4)
    V.2, review of research with, 248 (3)
Atomic Energy (*see* Nuclear energy)
Atomisation, 81 (2)
Attenuation (*see under* Radio transmission)

B

Ballistics, Rocket, external, 80 (1), 292 (13), 292 (14)
Banana River (*see under* Range, test, missile)
Body, Human
  effect of Acceleration, 147 (2), 248 (9), 291 (2)
  effect of Heat, 199 (11), 249 (1)
  effects of Space, 291 (1)

C

Ceramal
  General, 291 (4)
  Titanium carbide base, 291 (3)
    elevated temperature properties 149 (14)
Ceramic
    Porcelains, physical properties, 252 (1)
    Properties at high temperatures, 252 (2)
    Rocket applications, 251 (13)
    Strength and creep characteristics at high temperatures, 251 (14)
  for Turbine blades, 83 (3)
Cloud (*see under* Atmosphere)
Combustion (*see also under* Propellants, solid)
  Flames, ionisation and luminescence in, 199 (6)
  Problems, 149 (10)
  in Rockets, 251 (8), 293 (8)
  Wave, thermal structure, 295 (5)
Combustion Chamber (*see under* Rocket motor)
Communication
  between Heavenly bodies, 293 (3)
  Moon as relay, 249 (3)
Computer (*see under* Missile, guided)
Consolidated Vultee 744 (*see under* Missile, guided)
Cooling (*see also under* Rocket motor)
  Sweat, 291 (9), 291 (10)
    for Nozzles, 82 (1)
    rocket motor, 249 (7)
Cosmic Ray (*see under* Atmosphere, upper)

D

Data, Analyzing machine, 293 (1)
Decelerator, Rocket-propelled, Northrop, 203 (5), 203 (6), 203 (8)
Detroit Rocket Society, History of, 291 (7)
Diborane, Physical properties, 251 (11)

E

Earth, Viewed from high altitudes, 146 (7)

F

Flame (*see under* Combustion; Radio transmission)
Fuel (*see* Propellant)

G

Gas
  Flow
    adiabatic, application of near equilibrium criteria, 293 (11)
    effects of chemical transformations, 146 (2)
    rocket exhaust behaviour, 293 (4)
    thermodynamics of, 199 (5), 249 (11)
  Temperature and velocity measurement, 82 (3)
Gas Generator, for Propellant expulsion, 294 (6) P
G.E.C. (*see under* Rocket motor)

Geophysics, use of Rockets, 250 (3)
Guidance (*see under* Missile guided; V.2)
Gyropilot, made by Kreiselgeraete, 291 (14)

H

Heat Transfer, Supersonic convective on V.2, 82 (4)
Hydrazine, Explosive properties, 80 (2)
Hydrogen
  Atomic, as propellant, 251 (10)
  Propellant, tests, 295 (9)
  Thermal properties, 145 (3)
Hydrogen Peroxide
  Decomposition, 149 (12)
  Dielectric constant, 248 (2)
  Hundred percent, 251 (7)
  Manufacture, 149 (12)
  Physical properties, 251 (1)
  as propellant, 294 (9)

I

Ignition delay (*see under* Propellant)
Ignitor
  Composition, 149 (16) P, 200 (4) P, 203 (17) P
  Trap wire, 201 (1) P
Injector (*see under* Rocket motor)
Instrumentation (*see under* Aircraft, pilotless; Missile, guided; Rocket motor; V.2)
Ionosphere (*see under* Atmosphere)

J

Jet Propulsion Centre, Daniel and Florence Guggenheim (*see under* Rocket motor)

L

Life, Possibility on astronautical projectiles, 250 (9)

M

Mars, Vegetation, 290 (14)
Meteor, Determination of paths, 145 (2)
Missile
  Excitation of molecular vibrations by, 199 (2)
  Cooling, 201 (19)
  Thrust gauge for, 201 (23)
Missile, Guided (*see also* Ballistics, external; Gyropilot; Photography; Projectile, rocket; Range, test, missile; V.2; Viking)
  A.5, stability, 291 (17), 291 (19)
  Anti-bomber, 292 (18)
  Altitude recorder, heliographic 292 (8)
  Battery for use in German, 292 (2)
  Bulkhead ribs, heating of, 292 (3)
  Commercial possibilities, 83 (4)
  Committee on, 148 (10)
  Computer, performance, 202 (21)
    Consolidated Vultee 744, 84 (9)
    XSAM–N–4 (Lark), 202 (13), 292 (19)
  General, 84 (3), 84 (6), 84 (7), 84 (10), 84 (11), 84 (13), 148 (7), 202 (1), 202 (18), 250 (17), 292 (10)
Missile, Guided—contd.
  Guidance, 148 (9), 249 (19), 291 (20)
    relation between rudder drive and control equation, 201 (5)
  Hydraulics, 201 (17)
  Launching, 202 (9), 250 (6)
    correction of roll, 292 (1)
  Möller control apparatus, stability of missile with, 291 (18)
  North American NATIV, 84 (9), 84 (14)
  Operational aspects, 47 (1)
  Optical instrumentation, 146 (3)
  Production, 147 (11)
  Recovery, 292 (7)
  Rheinbote, 84 (15)
  Rheintochter, test firing, 291 (15)
  Ryan XAAM–A–1 (Firebird), 202 (11), 202 (19)
  Stability, 291 (16)
  U.S., 250 (8)
  Vertical climb, 291 (13)
  Wasserfall, 292 (11)
  X–4, 147 (12), 291 (12)
Moon
  Atmosphere, inquiry into, 248 (1)
  Microwave thermal radiation from 145 (1)
  as relay for communication, 249 (3)

N

Nativ (*see under* Missile, guided)
Navigation, Interplanetary, 46 (1), 290 (3), 290 (7), 290 (9), 290 (13)
Nitrogen dioxide (*see* Nitrogen tetroxide)
Nitrogen tetroxide
  Derivatives as propellants, 294 (12)
  as Propellant, 294 (7), 294 (10)
Nitromethane, as a Monopropellant, 82 (2), 149 (13)
NOTS, Inyokern (*see under* Range, test, missile)
Nozzle (*see also* Rocket motor)
  Expansion through, 81 (3), 148 (1)
    hydraulic analog, 85 (1)
Nuclear energy (*see also* Rocket motor)
  Aircraft propulsion, 147 (8)

O

Oberth, Hermann, interview with, 150 (3)
Oxygen, liquid, Handling, 294 (11)

P

Peenemünde (*see under* Rocket motor)
Pentaborane, Physical properties, 251 (11)
Photography
  Camera, multiple exposure for projectiles, 252 (3) P
  for guided missiles, 252 (4), 252 (5)
Pressurising (*see under* Rocket motor)
Projectile, Rocket (*see also* Ballistics, external; Missile, guided)
  Aircraft, 292 (15)
  Chinese, 148 (4)
  Escape, 45 (3)
    Fin assembly, 201 (14) P
    stabilising, 202 (21)

Projectile, Rocket—contd.
General, 84 (4), 148 (6), 203 (14), 249 (19)
Handling problems, 202 (2)
Holder, 200 (5) P
Launcher, 201 (8) P, 201 (9) P, 201 (11) P, 201 (13) P, 201 (15) P, 201 (18) P, 202 (5) P, 202 (6) P, 202 (8) P, 202 (10) P
Performance parameters, 81 (4)
Solid, 200 (6) P, 201 (6) P, 201 (7) P, 201 (10) P, 201 (12) P, 201 (16) P, 201 (20) P, 201 (21) P, 201 (22) P, 202 (7) P, 202 (17) P.
dispersion, 148 (14)
Step, 148 (15), 202 (21)
Trajectory, 148 (3), 202 (20)
Propellant (*see also* Aluminium borohydride; Hydrazine; Hydrogen; Hydrogen peroxide; Ignitor; Nitrogen tetroxide; Nitromethane; Oxygen, liquid; Rocket motor, nuclear energy; Tetranitromethane)
Atomisation, 81 (2)
Chemistry, 83 (2)
General, 294 (8)
High Energy, 200 (2), 251 (4)
Hydrides and organometallic compounds, 251 (5)
Ignition delay, measurement, 251 (12)
Monopropellant, 203 (18)
Nitric acid and alkyl—substituted mononuclear aromatic amines, 203 (19) P
Solid
combustion
kinetics, 295 (1), 295 (3)
radiation effect, 295 (6)
double-base, burning mechanism, 295 (2), 295 (8)
general, 203 (20) P, 203 (21) P
ignition, thermal, 295 (4)
polymers, 251 (2)
testing, 150 (2), 251 (9)
Terpenes as accelerators with hydrocarbons and nitric acid, 251 (3) P
Pulse-jet, 147 (9)
Pump, Centrifugal, 200 (7) P

R

Radar, use for determination of meteor paths, 145 (2)
Radiation (*see under* Rocket motor; Atmosphere)
Radio transmission
Attenuation in rocket flames, 293 (2)
between Heavenly bodies, 293 (3)
Ram jet, 147 (6), 147 (9), 202 (1)
Range, Test, Missile
Banana River, 85 (2), 202 (12)
General, 202 (4)
NOTS, Inyokern, 148 (13)
Woomera, Australia, 148 (12)
Reaction Motors, Inc. (*see under* Rocket motor)
Rheinbote (*see under* Missile, guided)
Rocket motor (*see also* Combustion; Cooling, sweat; Gas; Gas generator; Nozzle, expansion through; Pump; Tank)
for Aircraft, 147 (5)
B.M.W. 109–718, 147 (10)
Combustion chamber
heat flow in walls, 293 (5), 293 (9)
intermittent feed, 249 (4) P
refractory lining, 200 (9) P
rotating, 200 (11), 200 (22) P
steam production jacket, 249 (5) P
volume, calculation, 249 (4)
Control, 200 (12) P
Cooling, 47 (2)
fluid control, 200 (15) P
De Havilland Sprite, 200 (16), 201 (2), 249 (9), 249 (11)
Development, organisation for, 200 (18)
Gas, pressurised, 249 (10)
G.E.C. Malta test station, 203 (1)
General, 147 (6), 147 (9), 249 (19), 293 (6), 293 (7)
Injector, 83 (1), 200 (1), 200 (14) P
Instrumentation, 249 (13)
Jet guidance, 200 (20) P
Jet Propulsion Centre, Daniel and Florence Guggenheim, 293 (6), 294 (2)
Major developments, 84 (2)
Nozzle
adjustable, 200 (13) P
liquid cooled, 200 (21) P
Nuclear energy, application of, 45 (1), 200 (19), 249 (14)
Peenemünde, 250 (5), 291 (5), 291 (6)
Performance
non-uniform mixing, effect of, 200 (3)
radiation from flame, effect of, 147 (7)
Pressurising propellant tanks, 84 (18)
Problems, fundamental, 294 (1)
Production, 200 (10)
Progress, 202 (15), 203 (2)
Reaction Motors Inc, 249 (8)
Solid, 200 (8) P, 200 (17) P
instrumentation, 201 (3)
Testing, 84 (8), 84 (17), 148 (2), 294 (5), 295 (9)
Thermodynamics, 249 (15), 293 (10)
Rocket Propulsion
General, 83 (5), 84 (5), 202 (3), 249 (6), 249 (17), 249 (18), 249 (19), 250 (2), 250 (7), 250 (13), 294 (3)
Historical, 84 (1)
Rocket troop, Disbandment, 199 (1)

S

Satellite, artificial
Economics, 290 (5)
General, 83 (6), 84 (12), 149 (6), 203 (11), 203 (13), 203 (16), 290 (11)
Life on, possibility of, 250 (9)
Military use, 290 (4)
as a radio relay, 250 (11)
for Space navigation, 290 (3)
Space, legal claims, 250 (15)

Spaceflight (*see also* Navigation, interplanetary)
Energy problems, 290 (8)
Engineering problems, 250 (16)
and Films, 290 (12)
Flight paths, 149 (5), 149 (9)
General, 79 (1), 149 (7), 149 (8), 149 (10), 203 (10), 203 (12), 203 (14), 250 (10), 250 (13), 250 (14), 290 (2), 290 (6), 290 (10)
Propulsion problems, 149 (11)
Spaceship (*see also* Rocket, escape)
Practical, design of, 203 (15)
Space station (*see* Satellite, artificial)
Spectra, Solar, 81 (1)
Steam, Viscosity and heat conductivity, 199 (4)
Stratosphere (*see under* Atmosphere)
Superaerodynamics, 146 (1), 199 (2)
Sweat Cooling (*see under* Cooling)

T

Tank, Propellant, 45 (2)
Telemetering (*see also* Data)
General, 46 (2), 249 (2)
Multi-channel, 147 (3)
Transistor-oscillator, 147 (4)
Temperature, Flame, Measurement, 291 (8)
Terpenes (*see under* Propellant)
Test range, missile (*see under* Range, test, missile)
Tetranitromethane, Manufacture, 150 (1)
Thermodynamics (*see under* Rocket motor)
Thrust Gauge (*see under* Missile)

V

V-2
Accelerometer, 250 (1)
Ballistics, 80 (1), 249 (16), 250 (4)
Control and stability, 291 (11)
Electro-technics, 292 (20)
General, 203 (10)
Guide beam control
lateral, 292 (5)
signal, control constants, 201 (4), 292 (6)
Skin
heat transfer, 82 (4)
temperature, 292 (4)
Tail section, finding, 292 (16)
Testing, 202 (14)
Upper atmosphere research, 248 (3), 296 (3)
instrumentation, 146 (5)
Viking
General, 84 (16), 201 (24), 292 (9), 292 (12)
Ship firing, 292 (17)
Take-off, 148 (11)
Voltmeter, Electrostatic generating, rocket applications, 146 (4)

W

Wasserfall (*see under* Missile, guided)
Woomera (*see under* Range, test, missile)

Z

Zasyadko, 252 (6)

ABSTRACTS

AUTHOR INDEX

A

Abramson, B. N., 83 (1)
Africano, A., 200 (13) P
Aleksandrowicz, R., 248 (7)
Anderton, D. A., 292 (19)
Andreson, J., 203 (9)
Anwar, M., 203 (12)
Ault, G. M. (*see* Hoffman, C.A.)
Avery, W. H., 295 (7)

B

Bangs, S., 248 (9)
Bates, D. R., 199 (7)
Beaudry, S. B., 84 (6)
Bedford, T., 199 (11)
Beezhold, W. F., 202 (3)
Benson, B. S., 293 (1)
Bergen, W. B., 84 (10)
Bernstein, A. *et. al.*, 84 (17)
Berroth, A., 250 (3)
Bialoborski, E., 250 (14)
Bjork, C. F. 201 (1) P
and Woods, J. M., 202 (7) P
Blanc, P., 80 (1), 292 (13)
Bloom, R., Davis, N. S. and Levine, S. D., 294 (9)
Bobrowsky, A. R., 83 (3)
Bollay, W., 84 (11)
Bolz, R. E., 202 (20)
Boutet, R., 148 (3)
Bowen, I. S., 252 (2)
Bowen, W. A. (*see* Singer, S. F.)
Bowman, N., 251 (4), 294 (12)
and Proell, W., 251 (5)
Boxma, Ij., 249 (19)
Bredt, I.
(*see also* Sänger, E.), 82 (3)
Brest, R., 46 (1)
Brickwedde, F. G. (*see* Woolley, H. W.)
Broatch, J. D., 251 (12)
Buller, E. H. and Ford, B. H., 201 (17)
Burdick, M. D., Moreland, R. E. and Geller, R. F., 251 (13)
Burgess, E., 203 (13)
Burney, C. D., 202 (17) P
Burns, J. J. (*see* Scott, F. E.)
Bush, P., 202 (16)

C

Campbell, J. B., 291 (4)
Canright, R. B., 293 (8)
Carlson, G. R., 201 (3), 249 (13)

Carr, D. E., 203 (15) P
Carter, G. W., 201 (13) P
Chackett, K. F., Paneth, F. A., and Wilson, E. J., 199 (8), 295 (10)
Chandler, E. F., 292 (18)
Chazy, J., 149 (7)
Chilcote, W., 250 (15)
Clark, D. D., 248 (3)
Clark, J. F., 146 (4)
Clay, W. L., 202 (14)
Clauser, F. H., 79 (1)
Cleaver, A. V., 83 (5), 200 (19), 250 (13), 290 (10)
Cobb, H. M., 252 (4)
Conley, M., 290 (7)
Couperus, P. G., 84 (18)
Crawford, B. L., Huggett, C. and McBrady, J. J., 295 (2)
(*see also* Parr, R. G.)
Crocco, L., 293 (6)
Crowson, D. L., 146 (6)
Curtiss, C. F. and Hirschfelder, J. O., 199 (5)

D

Daniels, F. (*see* Wilfong, R. E.)
Davis, N. S. (*see* Bloom, R.)
Davis, T. L., 148 (4)
De Carvalho, H. G. (*see* Yagoda, H.)
De Castro Ramos, R., 251 (7)
De Koningh, G., 249 (19)
Débribéré, M., 146 (7)
Deutsch, G. C., Repko, A. J. and Lidman, W. G., 149 (14)
Dollfus, A. (*see* Lyot, B.)
Dow, W. G. (*see* Reifman, A.)
Durand, E., Oberly, J. J. and Tousey, R., 81 (1)
Duwez, P. (*see* Wheeler, H. L.)

E

Eagleston, I. (*see* Taylor, J.)
Ehricke, K. A., 250 (5), 291 (6)
Eichler, 291 (19)
Elmer, C. H., 252 (5)
Eltham, E., 147 (6)
Ensoll, J., 250 (17)
Escanglon, M. E., 250 (9)
Evans, S. H., 149 (4), 203 (5)

F

Fahrney, D. S., 84 (7)
Field, J. P., 149 (11)
Fischer, W. W. and Norris, R. H., 82 (4)
Ford, B. H. (*see* Buller, E. H.)
Frazer, J. H. and Hicks, B. L., 295 (4)
Frederick, 291 (14)
Fricke, 291 (15)
Friedman, H., 291 (11)
Friedman, J., 249 (7)
Frithsen, A. R., 202 (2)

G

Gangler, J. J. (*see* Hoffman, C. A.)
Gangnes, A. V. (*see* Van Allen, J. A.)
Garnier, M., 292 (15)
Gartmann, H., 147 (10), 147 (12), 250 (7), 290 (8), 290 (11)
Gatland, K. W., 149 (8), 203 (2)
Gebert, R., 291 (16)
Geckler, R. D., 203 (21) P
Geertsma, J., 294 (3)
Geller, R. F. (*see* Burdick, M. D. and Lang, S. M.)
Gertz, A. P., 83 (4)
Gibson, R. E., 202 (1), 295 (1)
Ginell, R. (*see* Rice, O. K.)
Goddard, R. H., 200 (7) P, 200 (9) P, 200 (11) P, 200 (14) P, 200 (15) P, 200 (20) P, 200 (21) P, 200 (22) P, 201 (19) P, 249 (4) P, 249 (5) P
Goehmann, M. H., 201 (21) P
Goercke, P., 293 (2)
(*see also* Sänger, E.)
Goff, M. R., 200 (5) P
Goodhue, W. V., 201 (9) P
Gordon, R., 293 (9)
Grad, H., 199 (2)
Gradecak, V., 149 (5)
Grant, L. J., 290 (3), 290 (5)
Greidanus, J. H., 249 (19)
Grieg, D. D., Metzger, S. and Waer, R., 249 (3)
Grootenhuis, P. (*see* Moore, N. P. W.)
Gross, P. M. and Taylor, R. C., 248 (2)

H

Hager, K. F., 150 (1)
Haggerty, J. J., 202 (11)
Hanley, E. J., 149 (16) P
Harry, C. H., 81 (4)
Hase, 292 (3)
Haviland, R. P., 84 (12)
Henry, J. P., 291 (1)
Hickman, C. N., 200 (4) P, 200 (8) P, 201 (10) P, 201 (12) P, 201 (23) P
Hicks, B. L. (*see* Frazer, J. H.)
Hild, 292 (4)
Himpan, J., 294 (4)
Hipp, K., 292 (7)
Hirschfelder, J. O. (*see* Curtiss, C. F.)
Hinckley, G. L., 46 (2)
Hoelker (*see* Schubert)
Hoelzgen, H. J., 251 (10)
Hoffman, C. A., Ault, G. M. and Gangler, J. J., 291 (3)
Hopkins, N. M., 201 (22) P
Hudiburg, H. B. and Thomas, R. G., 47 (1)
Huebler, J. (*see* Turin, J. J.)
Huggett, C. (*see* Crawford, B. L.)
Hughes, W. R., 148 (13)
Hurden, D., 293 (7)
Huse, A. K., 147 (5)
Hutchison, A. C. (*see* Taylor, J.)

I

Iacob, C., 83 (6)
Ihsen, H. C. (*see* Sanz, M. C.)

J

Johnson, P. D., 252 (2)
Jones, H. S., 248 (8)
Joyce, J. R., 81 (2)

K

Kaeppeler, J. E., 249 (14)
Kaiser, H. K., 290 (1)
Kalitinsky, A., 147 (8)
Kaplan, N. (*see* Yagoda, H.)
Keyes, F. G., 199 (4)
Kiepenheuer, K. O., 293 (3)
King, V. L., 203 (19) P
Kirschstein, F., 292 (20)
Klein, R., *et al.*, 295 (5)
Klemperer, W. B., 292 (8)
Kölle, H. H., 84 (1), 290 (6), 290 (9)
Kühme, H., 250 (4)

L

Lang, S. M., Maxwell, L. H. and Geller, R. F., 252 (1)
Latham, H. B., 199 (1)
Lauritsen, C. C. and McMorris, J., 200 (6) P, 201 (20) P, 201 (7) P, 201 (8) P
Lehan, W., 147 (4)
Levine, S. D. (*see* Bloom, R.)
Lewis, B. (*see* Scott, F. E.)
Ley, W., 250 (12)
Lidman, W. G. (*see* Deutsch, G. C.)
Lombard, C. F., 147 (2)
Ludwig, 291 (17), 291 (18), 291 (20), 292 (1)
Luntz, M., 146 (1)
Lyot, B. and Dollfus, A., 248 (1)

M

MacDonald, L. S., 201 (18) P
MacMillan, R. H., 202 (21)
Maple, E. (*see* Singer, S. F.)
Mathieu, L. S., 149 (12)
Maxwell, L. H. (*see* Lang, S. M.)
McBrady, J. J. (*see* Crawford, B. L.)
McKinley, D. W. R. and Millman, P. M., 145 (2)
McLarren, 148 (17), 149 (1), 149 (9), 203 (4), 249 (2), 249 (6)
McMarney, J. T., 84 (4)
McMorris, J. (*see* Lauritsen, C. C.)
Meinel, A. B., 202 (5) P
Melton, G. H., 147 (3)
Metzger, S. (*see* Grieg, D. D.)
Meyer-Hartwig, F., 82 (1)
Miles, M., 202 (9)
Miller, R. R. (*see* Smith, S. H.)
Millikan, C. B., 148 (10)
Millman, P. M. (*see* McKinley, D. W. R.)
Minnett, H. C. (*see* Piddington, J. H.)
Moore, N. P. W. and Grootenhuis, P., 291 (9)
Moore, T. M., 250 (1)
Moore, W. T., 250 (11)
Moreland, R. E. (*see* Burdick, M. D.)
Morrison, S. A., 148 (12)
Mundt, K. F., 84 (2)

N

Nagy, D. E. (*see* Sayward, J. M.)
Naugle, R. G., 84 (3), 292 (11)
Nazarek, A., 248 (4)
Nebbia, G., 294 (8)
Newell, H. E., 248 (5)
Nims, P. T., 202 (8) P
Norris, R. H. (*see* Fischer, W. W.)
Novikov, I. I., 146 (2)

O

Oberly, J. J. (*see* Durand, E.)
Oberth, H., 148 (9), 249 (15), 250 (2), 293 (10)
O'Day, M., 146 (5)

P

Paneth, F. A. (*see* Chackett, K. F.)
Parr, R. G. and Crawford, B. L., 295 (8)
Parsons, J. W., 200 (17) P
Patton, F. E., 291 (12)
Pearlman, B., 200 (18)
Pekkarinen, E., 150 (2)
Pendray, G. E., 249 (18)
Penner, S. S., 81 (3), 147 (7), 148 (1), 291 (8), 293 (11)
(*see also* Wilfong, R. E.)
Piddington, J. H. and Minnett, H. C., 145 (1)
Proell, W., 203 (15), 290 (4)
and Bowman, N., 251 (6)

R

Reichel, M., 290 (2)
Reifman, A. and Dow, W. G., 146 (8), 296 (3)
Reinhardt, T. F., 148 (20)
Repko, A. J. (*see* Deutsch, G. C.)
Reuyl, D., 146 (3)
Rice, O. K. and Ginell, R., 295 (6)
Roberts, H. E., 147 (1)
Ross, C. C. and Young, R. B., 45 (2)
(*see also* Zwicky, F.)
Ross, D. H., 294 (7), 294 (10)
Ross, H. E., 149 (10)
Roy, L., 203 (10)

S

Sänger, E., Bredt, I. and Goercke, P., 149 (9), 200 (2), 249 (10), 249 (12), 199 (6)
Sanz, M. C. and Ihsen, H. C., 293 (5)
Sawyer, E. V., 251 (2)
Sawyer, F. G., 83 (2)
Sayward, J. M. and Nagy, D. E., 251 (3) P
Schaub, W., 290 (13)
Schenk, H. V., 85 (1)
Schmidtmayer, J., 148 (15)
Schneider, J., 291 (2)
Scheonenberger, K. B., 295 (9)
Schubert and Spehr, 292 (5)
and Hoelker, 292 (6)
Schuyler, G. L., 202 (10)
Scott, F. E., Burns, J. J. and Lewis, B., 80 (2)

Scott, R. B. (*see* Woolley, H. W.)
Sellers, J. P., 45 (3)
Selwood, L. J. B., 47 (2)
Shloss, L., 250 (8)
Singer, S. F., Maple E. and Bowen, W. A., 248 (6)
Simpson, G. E., 294 (11)
Skinner, L. A., 148 (14), 201 (6) P, 201 (14) P, 201 (15) P, 203 (17) P
Slawsky, Z. I., 199 (3)
Sleutelberg, G. J., 249 (19)
Smith, S. H. and Miller, R. R., 251 (11)
Spehr, 201 (4), 201 (5)
(*see also* Schubert)
Stemmer, J., 250 (16)
Stockwell, R. E., 202 (4)
Summerfield, M., 294 (1)
Sutton, G. P., 292 (10)

T

Taylor, J., Hutchison, A. C. and Eagelston, I., 294 (6) P
Taylor, R. C. (*see* Gross, P. M.)
Thomas, R. G. (*see* Hudiburg, H. B.)
Tikhov, G. A., 290 (14)
Torrey, V., 199 (10)
Tousey, R. (*see* Durand, E.)
Tsien, H. S., 45 (1), 294 (2)
Turin, J. J. and Huebler, J., 149 (15)

U

Uhl, E. G., 201 (16) P

V

Van Allen, J. A. *et al.*, 148 (5)
and Ganges, A. V., 296 (1)
Van Den Bergh, S. J., 249 (19)

W

Waer, R. (*see* Grieg, D. D.)
Wagner, C., 200 (3)
Walker, B., 201 (11) P
Welsh, W., 250 (6)
Wendt, J., 203 (14)
Wheeler, H. L. and Duwez, P., 291 (10)
Wheeler, F. E., 202 (6) P
Wickson, A. K., 202 (18)
Wilfong, R. E., Penner, S. S. and Daniels, F., 295 (3)
Wilson, E. J. (*see* Chackett, K. F.)
Woods, J. M. (*see* Bjork, C. F.)
Woolley, H. W., Scott, R. B., and Brickwedde, F. G., 145 (3)
Wyld, J. H., 200 (12) P
Wyndham, C. H., 249 (1)

Y

Yagoda, H., De Carvalho and Kaplan, N., 296 (2)
Young, R. B. (*see* Ross, C. C.)

Z

Zaehringer, A. J., 203 (18), 251 (9), 291 (7)
Zeunert, G., 148 (6)
Zurmühl, R., 249 (16)
Zwicky, F., 251 (8)
and Ross, C. C., 82 (2)

THE

BRITISH INTERPLANETARY SOCIETY

(Limited by Guarantee)

Secretarial Address: 157, Friary Road, London, S.E.15

Lecture Programme: Session 1950-51

The following meetings of the British Interplanetary Society have been arranged for the 1950–51 session, at the times and places stated below.

Visitors are allowed to attend meetings of the Society, except where the notice specifically states that admission is by ticket only, in which case application must be made to the Secretary.

7 *October*, 1950, 6 *p.m.*

REPORT ON FIRST EUROPEAN ASTRONAUTICAL CONGRESS. This will consist of a series of impressions and reports by the British delegates to the First European Astronautical Congress, which is being held in Paris from 30th September to 2nd October, 1950, as a prelude to the International Congress to be held in London in September, 1951.

4 *November*, 1950, 6 *p.m.*

THE EARTH'S ATMOSPHERE, by J. Humphries, B.Sc. (Eng.), A.M.I.Mech.E., A.F.R.Ae.S. A review of our present knowledge of this subject, with special reference to the upper atmosphere.

PROBLEMS OF HIGH SPEED MISSILES ENTERING THE ATMOSPHERE, by T. R. F. Nonweiler, B.Sc. A discussion of the effects of air resistance on the heating of missiles, and the possibilities of using wings to effect a safe landing.

2 *December*, 1950, 6 *p.m.*

THE LUNAR BASE, by G. V. E. Thompson, B.Sc., A.R.C.S., A.R.I.C. The base to be described in this lecture would be constructed mainly for the refuelling and maintenance of spaceships, but could also act as headquarters for lunar exploration. Among the subjects to be dealt with will be the advantages which will result from the existence of such a base, possible sources of rocket fuel which may be present on the Moon, methods and plant for extracting and preparing these fuels, power generation, auxiliary equipment, buildings and other provisions for the welfare of the lunar staff. The problem of establishing the base will be discussed.

6 *January*, 1951, 6 *p.m.*

A SYMPOSIUM ON THE ORBITAL ROCKET. This will consist of three short talks on the problems affecting the design of close-orbit satellite vehicles.

(*a*) "The Orbital Rocket: Some Preliminary Considerations," by K. W. Gatland.

(*b*) "The Rocket Structure, with Special Reference to Expendable Construction," by A. E. Dixon.

(*c*) "Conception of an Instrument-carrying Orbital Rocket," by A. M. Kunesch.

3 *February*, 1951, 6 *p.m.*

INTERPLANETARY ORBITS, by J. G. Porter, Ph.D., F.R.A.S. In this talk, Dr. Porter, who is President of the British Astronomical Association and a member of the staff of the Nautical Almanac Office, Royal Greenwich Observatory, will discuss the principles determining the paths of rockets between the Earth, Moon and planets, their perturbations, and the methods of computation used.

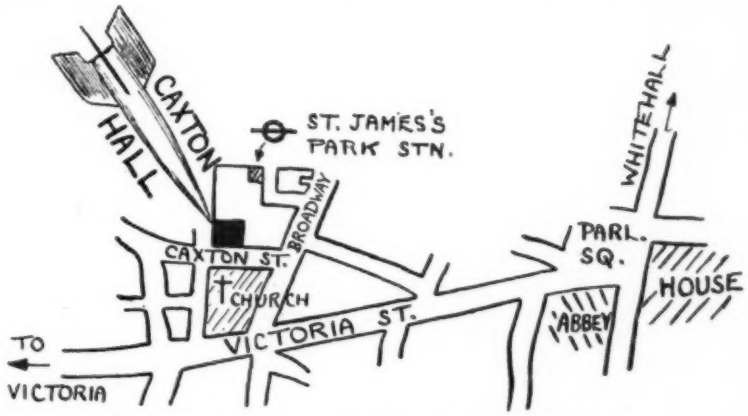
3 *March*, 1951, 6 *p.m.*

COMBUSTION IN THE ROCKET MOTOR, by Professor A. D. Baxter, M.Eng., A.M.I.Mech.E., A.F.R.Ae.S. Professor Baxter, late Superintendent of the Rocket Propulsion Department, Westcott, and now Professor of Aircraft Propulsion at the College of Aeronautics, Cranfield, will discuss the life history of droplets of propellant before, during and after their passage through the combustion chamber, and some of the associated problems facing the motor designer.

7 *April*, 1951, 6 *p.m.*

THE EVOLUTION OF LIFE IN THE UNIVERSE, by Professor J. D. Bernal, F.R.S. In this paper Professor Bernal will discuss the chemical and physical processes whereby life may arise on a planet under suitable conditions.

All the above meetings will take place at the Tudor Room, Caxton Hall, Westminster. Caxton Hall may be easily found as it is only a minute's walk from St. James's Park Underground Station (Metropolitan and District Lines). It is five minutes' walk from the Houses of Parliament along Victoria Street, and bus routes 10, 10a, 11, 24, 29, 39, 76, 134, 136 and 290 stop in the vicinity. A further route from Victoria Station along Victoria Street also takes about five minutes.



MAP SHOWING THE APPROACHES TO CAXTON HALL

North-Western District Centre

All meetings will be held at the Adult Education Institute, 49, Lower Mosley Street, Manchester, 2 (near to Central Station).

Further information regarding these lectures and the other activities of the North-Western District Centre may be obtained on application to the Branch Secretary, E. Burgess, 4, Cordova Avenue, Denton, near Manchester.

23 *September*, 1950. 7 *p.m.*

THE FIRST MOON ROCKET, by E. Burgess, F.R.A.S. Imaginary impressions of the experiences of the first space-travellers, how they will be clothed and fed, the types of things they will see and do, what they may expect to experience when on the Moon.

21 *October*, 1950. 7 *p.m.*

THE INTERPLANETARY PROJECT, by A. V. Cleaver, A.R.Ae.S. Aspects of interplanetary travel, difficulties in current research, probable future lines of development, scale, cost, economic and political effects, finance and organization.

25 *November*, 1950. 7 *p.m.*

THE GALAXY, by J. C. Farrer, F.R.A.S. An outline of modern theories regarding the origin and constitution of the galactic system and the place of our own solar system in relation thereto.

15 *December*, 1950. 8 *p.m.*

VISIT TO AN ASTRONOMICAL OBSERVATORY. This will be a restricted party and intending visitors should notify the Branch Secretary as soon as possible.

20 *January*, 1951. 7 *p.m.*

THE CHALLENGE OF THE SPACESHIP, by A. C. Clarke, B.Sc. An attempt to develop a philosophy of astronautics covering a large field, with emphasis on the philosophical, moral and social side of the problem of interplanetary flight and its impact upon human society.

17 *February*, 1951. 7 *p.m.*

THE DESIGN OF ROCKET MOTORS, by J. Humphries, B.Sc. (Eng.), A.F.R.Ae.S., A.M.I.Mech.E. An outline of the methods employed in the design of liquid propellant rocket motors, including choice of propellants, choice of propellant expulsion system, combustion chamber design, and methods of testing.

31 *March*, 1951. 2.15 *p.m.*

FILM SHOW. A special film show will include a programme of rocket and interplanetary films. Admission will be by ticket only, obtainable by sending stamped addressed envelope to the Branch Secretary.

21 *April*, 1951. 7 *p.m.*

THE PLANET MARS, by H. L. Dilks, F.R.A.S. A review of the physical conditions of the planet and the various theories regarding its evolution and what might be encountered there by travellers from Earth.

19 *May*, 1951. 7 *p.m.*

SHORT PAPER AND DISCUSSION EVENING. An opportunity for local members to deliver short papers to the Branch and also for members to discuss the earlier lectures and the future activities of the Branch.

21 *July*, 1951. 2.15 *p.m.*

SUMMER VISIT TO AN ASTRONOMICAL OBSERVATORY, giving members an opportunity to see how solar observations are made. The party will be restricted to fifteen members, and early application should be made to the Branch Secretary.

Birmingham and District Meetings

Early in 1951 it is hoped to provide a lecture and a film show for the benefit of members resident in and near Birmingham, admission to the latter being by ticket only.

A separate circular will be sent to all members in the area in due course, giving details of final arrangements.

W. H. & S.—79139